100/100 MARKS

ARTHAM
RESOURCE MATERIAL
NO. 1 EDUCATIONAL RESOURCES

NCERT
CHAPTER WISE
TOPIC WISE
LINE BY LINE QUESTIONS
2024

BY
SCHOOL OF
EDUCATORS

WORK, ENERGY AND POWER

WORK

- Work is said to be done when force produces displacement.

WORK DONE BY ALL FORCES

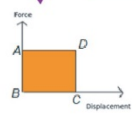
mg, Friction, Tension, Spring force, Pseudo, Normal

- $W = F\,d\cos\theta$.
- S.I. unit is J (Joule)

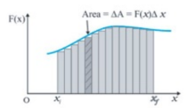
SPECIAL UNITS

- 1 hP = 746 W
- 1 KWH = 3.6×10^6 J

WORK DONE FOR CONSTANT FORCE & VARIABLE FORCE



- Area under F-S graph gives work done
- Work done = Area under ABCD



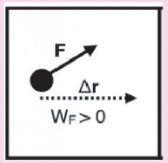
- If work is done by variable force, then $W = \int_{r_1}^{r_2} \vec{F}.d\vec{r}$

WORK CAN BE POSITIVE, NEGATIVE OR ZERO

POSITIVE WORK

(1) If force and displacement both are '+' or '–' and θ is acute.

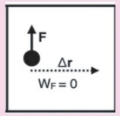
(2) If either of force or displacement is negative and θ is between 90° to 180°.



ZERO WORK

(1) W = 0. If force is perpendicular or to the displacement.

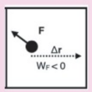
(2) Either force or displacement is zero.



NEGATIVE WORK

(1) If both force & displacement are '+' or '–' and θ is between 90° to 180°.

(2) If either of force or displacement is positive and θ is acute.



WORK DONE BY CONSERVATIVE & NON-CONSERVATIVE FORCES

CONSERVATIVE FORCES

(1) Kx, mg and electrostatic forces are conservative forces.

(2) Work for these forces is stored in the form of potential energy.

(3) They are path independent.

NON – CONSERVATIVE FORCES

(1) Non – conservative forces are path dependent.

(2) Friction is an example of non – conservative forces.

POWER

(1) Time rate at which work is done.

(2) It is a scalar quantity

(3) S.I. Unit is watt.

FORMULAE

(1) $dW = \vec{F}.d\vec{r}$

(2) $P = \dfrac{dW}{dt}$

For small amount of work

AVERAGE POWER

Total work done in time t is average power

$P_{avg} = \dfrac{W}{t}$

INSTANTANEOUS POWER

Scalar product of force and instantaneous velocity (V) is instantaneous power.

$\vec{P}_{inst} = \vec{F}.\dfrac{d\vec{s}}{dt} = \vec{F}.\vec{V}$

ENERGY

- Capacity to do work is defined as energy
- It is a scalar quantity
- S.I. unit is Joule (J)

VARIOUS FORMS

(1) Heat energy

(2) Chemical energy

(3) Electrical energy

(4) Nuclear energy

(5) Mass – Energy equivalence

WORK-ENERGY THEOREM

(1) Net work done on an object by all forces will change in kinetic energy of an object

(2) $W_{net} = \Delta K$

$W_{conservative} + W_{non\ conservative} + W_{ext} = \Delta K$

(3) $W = \int F(x).dx, \int F(x).dx = \Delta K + \Delta V$ if variable force does work.

MECHANICAL ENERGY IS CONSERVED

ENERGY IN SPRING MASS SYSTEM

(1) Total mechanical energy at each point is constant.

(2) $\Delta K + \Delta V = 0$

$(K_{initial} + V_{initial}) = (K_{final} + V_{final})$

(3) Maximum velocity

$V_{max} = x_m\sqrt{\dfrac{k}{m}}$

MOTION IN VERTICLE CIRCLE

(1) In absence of dissipative forces, mechanical energy is conserved

(2) $V = \sqrt{5gl}$ at bottom to reach top

(3) $V = \sqrt{3gl}$ at bottom to cross quarter circle

(4) $V = \sqrt{gl}$ to reach quatre circle

(5) Tension at any point on circle.

$T = \dfrac{m\mu^2}{r} - mg(2 - 3\cos\theta)$

(6) Velocity at any point on circle.

$V^2 = \mu^2 - 2gl(1 - \cos\theta)$

TYPES OF ENERGY

MECHANICAL ENERGY

Sum of kinetic energy and potential energy

KINETIC ENERGY

- By virtue of velocity $K = \dfrac{1}{2}mv^2$

POTENTIAL ENERGY

- By virtue of position, height, stresses within its & electrostatic factors:
- Gravitational potential energy = mgh
- Elastic potential energy = $\dfrac{1}{2}kx^2$
- Electrostatic potential energy = $\dfrac{kq_1q_2}{r}$

COLLISIONS

- An instance of one moving body striking with another
- Collision of car with truck, collision of balls in snooker are examples.

CONSERVATION OF MOMENTUM

(1) If netexternal force on system is zero then linear momentum of system is conserved

(2) $\Delta\vec{P} = 0$

(3) $\vec{P}_i = \vec{P}_f$

(4) $m_1\vec{\mu}_1 + \dots\dots + m_n\vec{\mu}_n = m_1\vec{\upsilon}_1 + \dots\dots + m_n\vec{\upsilon}_n$

NATURE OF COLLISIONS

- Value of coefficient of restitution defines nature of collision.

$e = \dfrac{V_{seperation}}{V_{approach}}$

- e = 0, e = 1, $0 < e < 1$ Defines nature of collisions

TYPES OF COLLISIONS

- In elastic collision, momentum and K.E of system are conserved
- e = 1
- Bodies do not stick together after collision

- In inelastic collision, momentum is conserved
- $0<e<1$
- Bodies do not stick together after collision

- In perfectly inelastic collison momentum is conserved
- e = 0
- Bodies sticks together after collision

1 – D COLLISION

(1) $(\Delta P)_{sys} = 0$

(2) $e = \dfrac{V_2 - V_1}{\mu_1 - \mu_2}$

(3) $V_1 = \left(\dfrac{m_1 - em_2}{m_1 + m_2}\mu_1 + \dfrac{(1+e)m_2}{m_1 + m_2}\mu_2\right)$

Velocity of first particle after collision.

(4) $V_2 = \dfrac{m_1 - (1+e)}{m_1 + m_2}\mu_1 + \dfrac{m_2 - em}{m_1 + m_2}\mu_2$

Velocity of second particle after collision

(5) Change in kinetic energy, ΔK

$\Delta K = \dfrac{1}{2}\dfrac{m_1m_2}{m_1 + m_2}(\vec{\mu}_1 - \vec{\mu}_2)^2(1 - e)$

2 – D COLLISION

(1) Bodies moving in a plane results in arbitrary collision in different directions is 2 – D.

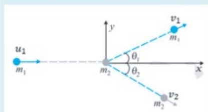
(2) $\Delta\vec{P} = 0$

$\Delta P_x = 0$

$m_1\mu_1x + m_2\mu_2x = m_1v_1x + m_2v_2x$

$\Delta P_y = 0$

$m_1\mu_1y + m_2\mu_2 = m_1v_1y + m_2v_2y$



SPECIAL CASES

(1) $h_n = e^{2n}\,h_0$

e = coefficient of restitution.

n = nth collision.

ho = initial height.

hn = height after nth collision

(2) Vn = enVo.

n = nth collision.

Vo = initial velocity.

Vn = velocity after nth collision.

(3) $H = h_0\left(\dfrac{1+e^2}{1-e^2}\right)$

H = total distance travelled before it stops

(4) $T = \left(\dfrac{1+e^2}{1-e^2}\right)\sqrt{\dfrac{2h_o}{g}}$

T = time taken by ball to stope bounding.

NCERT LINE BY LINE QUESTIONS

1. What is the angle between force $\vec{F}=3\hat{i}+4\hat{j}-5\hat{k}$ unit and displacement $\vec{S}=4\hat{j}+3\hat{k}$ unit?

   1) $\cos^{-1}\left(\frac{1}{5\sqrt{2}}\right)$ 2) $\cos^{-1}\left(\frac{1}{25\sqrt{2}}\right)$ 3) $\cos^{-1}\left(\frac{1}{5}\right)$ 4) $\cos^{-1}\left(\frac{1}{25}\right)$

2. A force F = 20 N acts on a object and displaces it from rest to speed of 10 m/s in its direction. What is displacement, if mass of object is 2 kg?

   (1) 6m (2) 5 m (3) 12 m (4) 10 m

3. Raindrop is falling downwards under influence of gravity and opposing resistive force. Consider a drop of mass 5.00 g falling from height of 500 m and hits ground with speed of 70 m s^{-1}. What is work done by resistive force?

   (1) -7.85 J (2) -9.50 J (3) -12.75 J (4) -13.50 J

4. A cyclist comes to skidding stop in 6 m. During this process the force on cycle due to road is 120 N and is opposing the motion. How much work does road do on cycle?

   (1) -720 J (2) -420 J (3) 20 J (4) Zero

5. A shooter fires a bullet of mass 50 g with speed of 200 m s^{-1} on softwood of thickness 2 cm. If bullet looses 80% of its kinetic energy and emerges out. What is emergent bullet speed?

   (1) 89.4 ms^{-1} (2) 69.5 ms^{-1} (3) 100 ms^{-1} (4) 20.0 ms^{-1}

6. A woman pushes a box on railway platform which has rough surface. She applies a force of 20 N over a distance of 5 m thereafter gets tired and applied force which reduces linearly to 10 N with distance. The total distance which box has been moved is 10 m. Work done during second displacement is

   (1) 175 J (2) 19.5 J (3) 75J (4) 14.65 J

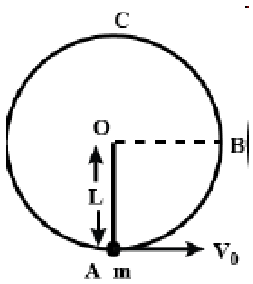
7. A block of mass m = 1 kg is moving on horizontal surface with speed of 4 m s^{-1} enters a rough patch ranging from x = 0.1 m tox = 1.6 m. The retarding force in this range is inversely proportional to x

   $F=-\frac{1}{x}$ (0.1 < x < 1.6 m)

   What is final kinetic energy of the body?

   (1) 9.2J (2)7.3J (3) 6.84 J (4) 5.23 J

8. A bob of mass *m* is suspended by light string of length *l*. At lowest position it is imparted a horizontal velocity $\sqrt{5gl}$ such that it just completes circular trajectory in vertical circle. What is ratio of its KE at *B* and C?



   (1) 2:1 (2) 3:1 (3) 5:3 (4) 3:2

9. The potential energy of a body as a function of distance is given as ***U(x)*** **=** $(-6x^2 + 2x)$ J
The conservative force acting on body at x = 1 m will be
(1) 6N (2) 8N (3) 10 N (4) 12 N

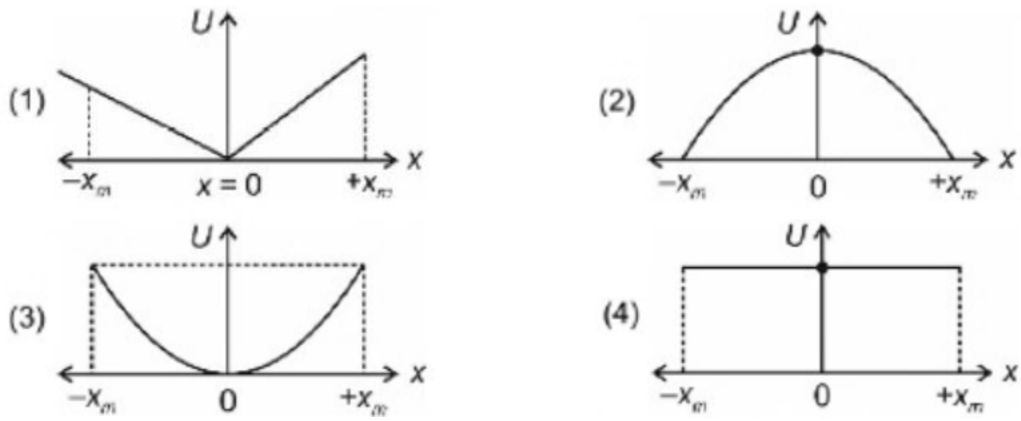
10. Consider the following statements.
A; Spring force is deformation dependent.
B: Work done by Spring force depends on initial and final deformation.

(1) Both statements are true (2) Both statements are false
(3) Only first statement is true (4) Only second statement is true

11. A spring is executing motion about equilibrium position ***x*** **=** 0 where we take potential energy of spring to be zero. The spring is oscillating between $-x_m$ and $+x_m$ position with a mass ***m*** attached. During motion, maximum speed of spring will be

1) $2\sqrt{\frac{k}{m}}x_m$ 2) $\sqrt{\frac{k}{m}}x_m$ 3) $\sqrt{\frac{k}{2m}}x_m$ 4) $\sqrt{\frac{k}{m}}\left(\frac{x_m}{2}\right)$

12. The graph between potential energy ***(U)*** of a spring versus its position (x) is best shown by graph (equilibrium ***x*** = 0)

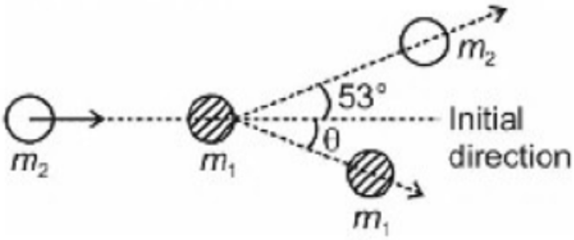


13. Consider a situation in which a car of mass 2000 kg moving with speed of 54 km/h on a smooth road and colliding with a horizontal mounted spring of spring constant 12.5 10^3 Nm^{-1}. What is maximum compression of spring?
(1) 4m (2) 6 m (3) 8 m (4) 1 m

14. An elevator can carry a maximum load of 900 kg (elevator + passengers) is moving up with constant speed of 2 m s^{-1}. A constant frictional force of 5000 N opposes the motion. What minimum power is delivered by motor (in HP)?
(1) 37.5 HP (2) 32.5 HP (3) 42.5 HP (4) 50.2 HP

15. Two objects with mass mi = 2 kg and ***rm*** **=** 3 kg collides perfect inelastically. The particles were moving with speed of 10 m s^{-1} and zero respectively before collision. The loss of KE on collision is
(1) 60 J (2) 40 J (3) 100 J (4) 90 J

16. Consider a collision between two identical billiard balls with equal masses $m_1 = m_2 = m$.
First ball was at rest and second hits it on edge. Second ball after hitting moves through an angle of 53° to initial direction. Assuming elastic collision, the angle through which first ball moves with initial line after collision is



(1) 53° (2) 47° (3) 37° (4) 90°

17. In a nuclear reactor, a neutron of high speed 10^4 m s^{-1} collides elastically with a light nuclei of deuterium (at rest). The collision results in loss of KE of neutron. What fraction of KE is lost by neutron?

1) $\frac{1}{4}$ 2) $\frac{2}{5}$ 3) $\frac{1}{9}$ 4) $\frac{2}{9}$

18. A bullet of mass 12 g and moving with horizontal speed of 100 m s^{-1} strikes a block of wood of mass 348 g and instantly comes to rest with respect to block. The block is suspended from ceiling by means of a thin wire. The height through which block rises is

(1) 0.55 m (2) 0.88 m (3) 0.77 m (4) 1.22 m

19. The blades of wind mill sweep out a circle of area $A = 2$ m². The wind is flowing at velocity v = 6 m s 1 perpendicular to circle, the density of air is 1.2 kg nr³. What is power generated?

(1) 160.8 W (2) 259.2 W (3) 302.5 W (4) 239.2 W

20. An electron and a proton are detected in cosmic ray experiment. The electron has kinetic energy of 20 keV and proton has 50 keV. The ratio of speed of electron to proton is(m_e=9 10^{-31} kg, m_p= 1.6$10^{-27}$ kg)

(1) 157 (2) 17,5 (3) 26.6 (4) 4.9

NCERT BASED PRACTICE QUESTIONS

1. Which of the following relation show work energy theorem

(a) Δk = w (b) ΔU = w (c) ΔU = - Wc (d) None of these

2. Which of the following correctly represent work done by a constant force

(a) w = $\overline{F}.\overline{d}$ (b) w = $\overline{F}\times\overline{d}$ (c) w = $\overline{F}+\overline{d}$ (d) w = $\overline{F}-\overline{d}$

3. A stone is whirled in a circle by tiding it at one end of a string. Then work done by the tension in the string is

(a) Negative (b) Positive (c) zero (d) cannot be said

4. Work done by the spring force is

(a) Positive (b) Negative (c) zero (d) none of these

5. A particle have mass m moving with momentum P then kinetic energy of the particle is.

(a) P 2m (b) $\frac{P^2}{m}$ (c) Pm (d) $\frac{P^2}{2m}$

6. Work done by a force is work done under graph

(a) F – t (b) F – x (c) F – υ (d) a – x

7. A block of mass m = 1kg moving on a horizontal surface with speed υ_i= 2 m/s enters a rough patch ranging from x = 0.10m to x = 2.01m. The retarding for u from the block

in this range is inversely proportional to x over this region Fr = $\frac{-k}{x}$.k = 0.5J The final kinetic energy of the block? log (20.1) =0.5
(a) 1J (b) 0.5 J (c) 1.5 J (d) 2J

8. Conservation of mechanical energy is applicable when
(a) No external force is acting (b) external force is acting
(c) Friction force is present (d) Always applicable

9. Which of the following is correct?
$W_{external} + W_{gravitation} + W_{internal} =$
(a) $U_f - U_i$ (b) $K_f - K_i$
(c) T. E_f – T E_i (d) all of above

10. Minimum speed required by the particle to complete a vertical circle at the lowest point is
(a) $\sqrt{3gl}$ (b) $\sqrt{2gl}$ (c) $\sqrt{5gl}$ (d) $\sqrt{gl}$

11 Minimum speed of the particle moving in a vertical circle when string is horizontal to complete the circle is
(a) $\sqrt{3gl}$ (b) $\sqrt{2gl}$ (c) $\sqrt{5gl}$ (d) $\sqrt{gl}$

12. Total energy of a particle moving in a vertical circle to just complete the circle is
(a) $\frac{3}{2}mgl$ (b) $\frac{5}{2}mgl$ (c) $\frac{7}{2}mgl$ (d) $\frac{1}{2}mgl$

13. Which of the following is not a conservative force?
(a) Gravitational force (b) Electrostatic force
(c) Spring force (d) Frictional force

14 Instantaneous power delivered by the body is
(a) P = $\vec{F}.\vec{u}$ (b) P = $\frac{w}{t}$ (c) P = $\frac{w_{totla}}{t_{total}}$ (d) None of these

15. 1 kwh =
(a) 3.6×10^5J (b) 3.6×10^4J
(c) 3.6×10^6J (d) 3.6×10^3J

16. For completely inelastic collision final velocity of the particles initially moving with velocity V_1 and V_2 is
(a) $\frac{m_1v_1 + m_2v_2}{m_1 + m_2}$ (b) $\frac{m_1v_1}{m_1 + m_2}$
(c) $\frac{m_2v_2}{m_1 + m_2}$ (d) $\frac{m_1v_1 - m_2v_2}{m_1 + m_2}$

17. Which of the following is correct for perfectly elastic collision?
(a) $P_i = P_f$ $k_i > k_f$ (b) $P_i > P_f$, $K_i = k_f$
(c) $P_i = P_f$, $k_i = k_f$ (d) $P_i = P_f$ $k_i < k_f$

18. Which of the following relation is true for perfectly elastic collision?
(a) Velocity of separation = velocity of approach
(b) Velocity of separation > velocity of approach

(c) Velocity of separation < velocity of approach (d) None of these

19. A body of mass 2kg initially at rest moves under the action of an applied horizontal force of 7N on a table with coefficient of kinetic friction = 0.1 work done by the applied force in 10s is

(a) – 247 J (b) 882 J (c) 605 J (d) 1129J

20. The potential energy function for a particle executing simple harmonic motion is v(x) = $\frac{kx^2}{2}, k = 0.5N/m$. The particle turn back when it reaches x = ±2m then total energy of the particle is

(a) 2J (b) 4 J (c) 1J (d) $\frac{1}{2}$J

21. When a conservative force does positive work on a – The potential energy of the body
(a) increases (b) decreases
(c) remain unchanged (d) become zero

22. Work done by a body against frictional always results in a loss of its
(a) kinetic energy (b) potential energy
(c) total energy (d) there is no loss of energy

23. The rate of change of total momentum of a many – particle system is proportional to
(a) internal force (b) external force
(c) gravitation force (d) none of these

24. In an inelastic collision of two bodies, the quantities which do not change after the collision is
(a) Kinetic energy (b) total linear momentum
(c) total energy of the system (d) none of these

25. Which of the following statement is correct?
(a) In an elastic collision of two bodies the total momentum and energy of bodies is conserved
(b) Total energy of the system is always conserved no matter what internal and external forces on the body are present
(c) Work done in the motion of a body over a closed loop is zero for very very force in nature.
(d) In an inelastic collision, the final kinetic energy is always less than the intial kinetic energy of the system

26. A body is initially at rest. It undergoes one – dimensional motion with constant acceleration. The power delivered to it at time t is proportional to
(a) $t^{1/2}$ (b) t (c) $t^{3/2}$ (d) t^2

27. A body is moving unidirectionally under the influence of a source of constant power. Its displacement in time t is proportional to
(a) $t^{1/2}$ (b) t (c) $t^{3/2}$ (d) t^2

28. An electron and a proton are detected in a cosmic ray experiment the first with kinetic energy 10 KeV and the second with 100 KeV. Ratio of their speeds is
(a) 1 (b) 12.5 (c) 13.5 (d) 18.5

29. A pump on the ground floor of a building can pump up water to fill a tank of volume $30m^3$ in 15min. If the tank is 40m above the ground and the efficiency of the pump is 30% how much electric power is consumed by the pum?
(a) 40 kw (b) 43.6 w (c) 54 w (d) 43.6 kw

30. A body constrained to move along the z – axis of a coordinate system is subjected to a constant for F = $-\hat{i} + 2\hat{j} + 3\hat{k}$.Then work done by this force in moving the body a distance 4m along the y – axis is

(a) - 4J (b) 8 J (c) 12 J (d) 16 J

31. A body of mass 0.5kg travels in a straight line with velocity $\upsilon = ax^{3/2}$ where a = 5 $m^{-1/2}$ 5^{-1} . Then work done by the net force during its displacement from x = 0 to x = 2m is

(a) 30J (b) 40 J (c) 60J (d) 50J

32. A molecule in a gas container hits a horizontal wall will speed 200m/s and angle 30^0 with the normal and rebounds with the same speed. Then collision of the particle is

(a) Perfectly elastic (b) Perfectly inelastic
(c) partially inelastic (d) can not be said

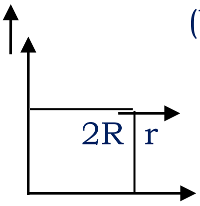
33. Two identical ball bearings in contact with each other and resting or a frictionless table are hit head on by another ball bearing of the same mass moving initially with a speed V. If the collision is elastic which of the following is a possible result after collision

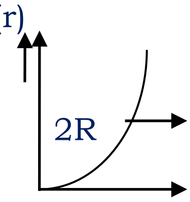
(a) $\underset{v=0}{\overset{1}{O}}\ \overset{2\ 3}{OO}\underset{\frac{v}{2}}{\rightarrow}$ (b) $\underset{v=o}{\overset{1\ 2}{OO}}\ \overset{3}{O}\underset{v}{\rightarrow}$ (c) $\overset{1\ 2\ 3}{OOO}\underset{\frac{v}{3}}{\rightarrow}$ (d) $\overset{OOO}{\underset{V}{\rightarrow}}$

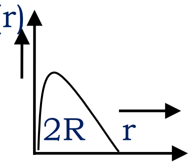
34. A family uses 8kw of power. Direct solar energy is incident on the horizontal surface at an average rate of 200w/m^2. If 20% of this energy can be converted to useful electrical energy how large an area is needed to supply 8kw

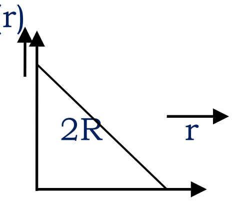
(a) 100m^2 (b) 400 m^2 (c) 200 m^2 (d) 600m^2

35. Which of the following potential energy curve represent the elastic collision of two billiard balls

(a) v (r)


(b) v(r)


(c) v(r)


(d)v(r)


36. A bolt of mass 0.3kg falls from the ceiling of an elevator moving down with an uniform speed of 7m/s. It hits the floor of the elevator (length of elevator = 3m) and does not rebond. Heat produced in this impact is

(a) 6.42J (b) 4.41 J (c) 8.82J (d) None of these

37. Coefficient of restitution is

(a) $\frac{\text{velocity of separation}}{\text{Velocity of approach}}$

(b) velocity of separation x velocity of approach

(c) $\frac{\text{Velocity of approach}}{\text{Velocity of separation}}$

(d) none of these

38. If a ball is released from a height n. Hits a surface and rebound if coefficient of restitution between ball and surface is 'e' then height attained by the ball after first rebound is

(a) $\frac{h}{e}$ (b) e^2h (c) e h (d) none of these '

39. If a ball nit a surface with velocity v. If coefficient between ball and surface is e then velocity of rebound is

(a) e^2 v (b) $\frac{v}{e}$ (c) e v (d) none of these

40. If a ball of mass m elastically collide with a ball of same mass resting on the surface the velocity of the bal after collision are v_1 and v_2 then

(a) V_1 = V. V_2 = 0 (b) V_1 = 0 , V_2 = V

(c) V_1 = V, V_2 = V (d) None of these

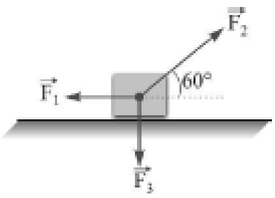
TOPIC WISE PRACTICE QUESTIONS

Topic 1: Work

1. A force $\vec{F} = (5\vec{i} + 3\vec{j} + 2\vec{k})$ N is applied over a particle which displaces it from its origin to the point $\vec{r} = (2\vec{i} - \vec{j})$ m. The work done on the particle in joule is

(1) +10 (2) +7 (3) –7 (4) +13

2. Figure shows three forces applied to a trunk that moves leftward by 3 m over a smooth floor. The force magnitudes are F_1 = 5N, F_2 = 9N, and F_3 = 3N. The net work done on the trunk by the three forces



(1) 1.50 J (2) 2.40 J (3) 3.00 J (4) 6.00 J

3. A man pushes a wall and fails to displace it. He does

(1) negative work (2) positive but not maximum work

(3) no work at all (4) Maximum work

4. Given that a force $\hat{F}$ acts on a body for time t, and displaces the body by $\hat{d}$. In which of the following cases, the speed of the body must not increase?

(1) F > d (2) F < d (3) $\hat{F} = \hat{d}$ (4) $\hat{F} \perp \hat{d}$

5. A force acts on a 30 gm particle in such a way that the position of the particle as a function of time is given by $x = 3t - 4t^2 + t^3$, where x is in metres and t is in seconds. The work done during the first 4 seconds is

(1) 576 mJ (2) 450 mJ (3) 490 mJ (4) 530 mJ

6. A particle moving in the xy plane undergoes a displacement of $\vec{s} = (2\hat{i} + 3\hat{j})$ while a constant force $\vec{F} = (5\hat{i} + 2\hat{j})$ acts on the particle. The work done by the force F is

(1) 17 joule (2) 18 joule (3) 16 joule (4) 15 joule

7. A boy pushes a toy box 2.0 m along the floor by means of a force of 10 N directed downward at an angle of 60° to the horizontal. The work done by the boy is

(1) 6 J (2) 8 J (3) 10 J (4) 12 J

8. A body moves a distance of 10 m along a straight line under the action of a force of 5 newtons. If the work done is 25 joules, the angle which the force makes with the direction of motion of body is
(1) 0º (2) 30º (3) 60º (4) 90º

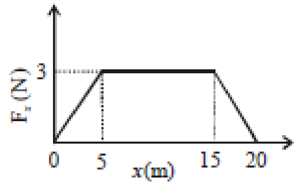
9. If a motorcyclist skids and stops after covering a distance of 15 m. The stopping force acting on the motorcycle by the road is 100 N, then the work done by the motorcycle on the road is
(1) 1500 J (2) –1500 J (3) 750J (4) Zero

10. A uniform force of $\left(3\hat{i}+\hat{j}\right)$ newton acts on a particle of mass 2 kg. The particle is displaced from position $\left(2\hat{i}+\hat{k}\right)$ meter to position $\left(4\hat{i}+3\hat{j}-\hat{k}\right)$ meter. The work done by the force on the particle is
(1) 6 J (2) 13 J (3) 15 J (4) 9 J

11. The position of a particle of mass 4 g, acted upon by a constant force is given by $x = 4t^2 + t$, where x is in metre and t in second. The work done during the first 2 seconds is
(1) 128 mJ (2) 512 mJ (3) 576 mJ (4) 144 mJ

12. If work done on a system, depends upon initial and final positions only then, it can be due to
(1) a conservative or non conservative force (2) a conservative force
(3) a non-conservative force (4) None of these

13. A force F_x acts on a particle such that its position x changes as shown in the figure. The work done by the particle as it moves from x = 0 to 20 m is



(1) 37.5 J (2) 10 J (3) 45 J (4) 22.5 J

14. A particle moves from position $\vec{r}_1 = 3\hat{i}+2\hat{j}-6\hat{k}$ to position $\vec{r}_2 = 14\hat{i}+13\hat{j}+9\hat{k}$ under the action of force $4\hat{i}+\hat{j}+3\hat{k}$ N. The work done will be
(1) 100 J (2) 50 J (3) 200 J (4) 75 J

15. A man drags a block through 10 m on rough surface (μ = 0.5). A force of $\sqrt{3}$ kN acting at 30° to the horizontal. The work done by applied force is
(1) zero (2) 15 kJ (3) 5 kJ (4) 10 kJ

16. A spring of spring constant 5×10^3 N/m is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is
(1) 18.75 J (2) 25.00 J (3) 6.25 J (4) 12.50 J

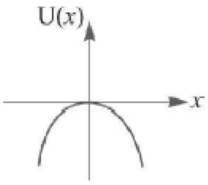
Topic 2: Energy

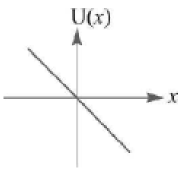
17. One man takes 1 min. to raise a box to a height of 1 metre and another man takes 1/2 min. to do so. The energy of the
(1) two is different (2) two is same (3) first is more (4) second is more

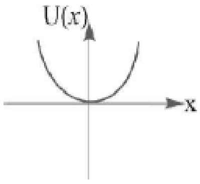
18. A metallic wire of length L metre extends by l metre when stretched by suspending a weight Mg from it. The mechanical energy stored in the wire is
(1) $2Mg\ell$ (2) $Mg\ell$ (3) $\frac{Mg\ell}{2}$ (4) $\frac{Mg\ell}{4}$

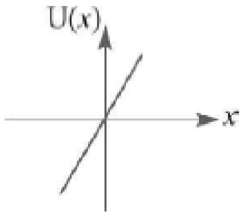
19. If the momentum of a body is increased by 50%, then the percentage increase in its kinetic energy is
(1) 50% (2) 100% (3) 125% (4) 200%

20. A particle is placed at the origin and a force $F = kx$ is acting on it (where k is positive constant). If $U(0) = 0$, the graph of $U(x)$ versus x will be (where U is the potential energy function) :

(1) 

(2) 

(3) 

(4) 

21. A ball is allowed to fall from a height of 10 m. If there is 40% loss of energy due to impact, then after one impact ball will go up to

(1) 10 m (2) 8 m (3) 4 m (4) 6 m

22. A body accelerates uniformly from rest to a velocity of 1 ms^{-1} in 15 seconds. The kinetic energy of the body will be $\frac{2}{9}$J when 't' is equal to [Take mass of body as 1 kg]

(1) 4s (2) 8s (3) 10s (4) 12s

23. The potential energy of a conservative system is given by $U = ay^2 - by$, where y represents the position of the particle and a as well as b are constants. What is the force acting on the system ?

(1) – ay (2) – by (3) 2ay – b (4) b – 2ay

24. The kinetic energy of particle moving along a circle of radius R depends upon the distance covered S and is given by K = aS where a is a constant. Then the force acting on the particle is

(1) $\frac{aS}{R}$ (2) $\frac{2(aS)^2}{R}$ (3) $\frac{aS^2}{R^2}$ (4) $\frac{2aS}{R}$

25. A body starts from rest and acquires a velocity V in time T. The work done on the body in time t will be proportional to

(1) $\frac{V}{T}t$ (2) $\frac{V^2}{T}t^2$ (3) $\frac{V^2}{T^2}t$ (4) $\frac{V^2}{T^2}t^2$

26. A spring of unstretched length *l* has a mass m with one end fixed to a rigid support. Assuming spring to be made of a uniform wire, the kinetic energy possessed by it if its free end is pulled with uniform velocity v is:

(1) $\frac{1}{2}mv^2$ (2) mv^2 (3) $\frac{1}{3}mv^2$ (4) $\frac{1}{6}mv^2$

27. Two springs of force constants 300 N/m (Spring A) and 400 N/m (Spring B) are joined together in series. The combination is compressed by 8.75 cm. The ratio of energy stored in A and B is

(1) $\frac{4}{3}$ (2) $\frac{16}{9}$ (3) $\frac{3}{4}$ (4) $\frac{9}{16}$

28. A rubber ball is dropped from a height of 5m on a plane, where the acceleration due to gravity is not yet calculated. On bouncing it rises to 1.8 m. The ball loses its velocity on bouncing by a factor of

(1) $\frac{16}{25}$ (2) $\frac{2}{5}$ (3) $\frac{3}{5}$ (4) $\frac{9}{25}$

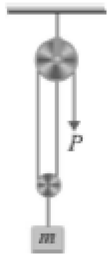
29. A mass of M kg is suspended by a weightless string. The horizontal force that is required to displace it until the string makes an angle of 45° with the initial vertical direction is

(1) $Mg\left(\sqrt{2}+1\right)$ (2) $Mg\sqrt{2}$ (3) $\frac{Mg}{\sqrt{2}}$ (4) $Mg\left(\sqrt{2}-1\right)$

30. A body is allowed to fall freely under gravity from a height of 10m. If it looses 25% of its energy due to impact with the ground, then the maximum height it rises after one impact is

(1) 2.5m (2) 5.0m (3) 7.5m (4) 8.2m

31. The block of mass m is pulling, vertically up with constant speed, by applying force *P*. The free end of the string is pulled by *l* meter, the increase in potential energy of the block is :



(1) $\frac{mgl}{2}$ (2) mgl (3) $2mgl$ (4) $\frac{mgl}{4}$

Topic 3: Power

32. Ten litre of water per second is lifted from a well through 10 m and delivered with a velocity of 10 ms^{-1}. If g = 10 ms^{-2}, then the power of the motor is
(1) 1 kW (2) 1.5 kW (3) 2 kW (4) 2.5 kW

33. How much water, a pump of 2 kW can raise in one minute to a height of 10 m, take g = 10 m/s^2?
(1) 1000 (2) 1200 (3) 100 (4) 2000

34. A body of mass m accelerates uniformly from rest to v_1 in time t_1. As a function of t, the instantaneous power delivered to the body is
(1) $\frac{mv_1t}{t_1^2}$ (2) $\frac{mv_1^2t}{t_1}$ (3) $\frac{mv_1t^2}{t_1}$ (4) $\frac{mv_1^2t}{t_1^2}$

35. Johnny and his sister Jane race up a hill. Johnny weighs twice as much as Jane and takes twice as long as Jane to reach the top . Compared to Jane
(1) Johnny did more work and delivered more power.
(2) Johnny did more work and delivered the same amount of power.
(3) Johnny did more work and delivered less power
(4) Johnny did less work and delivered less power.

36. If a force F is applied on a body and it moves with a velocity v, the power will be
(1) F × v (2) F/v (3) F/v^2 (4) $F \times v^2$

37. An electric motor exerts a force of 40 N on a cable and pulls it by a distance of 30 m in one minute. The power supplied by the motor (in watt) is
(1) 20 (2) 200 (3) 2 (4) 10

38. An engine pumps water continuously through a hose. Water leaves the hose with a velocity v and m is the mass per unit length of the water jet. What is the rate at which kinetic energy is imparted to water?
(1) mv^2 (2) $\frac{1}{2}mv^2$ (3) $\frac{1}{2}m^2v^2$ (4) $\frac{1}{2}mv^3$

39. If two persons A and B take 2 seconds and 4 seconds respectively to lift an object to the same height *h*, then the ratio of their powers is
(1) 1 : 2 (2) 1 : 1 (3) 2 : 1 (4) l : 3

40. A body of mass 10 kg moves with a velocity v of 2 m/s along a circular path of radius 8 m. The power produced by the body will be
(1) 10 J/s (2) 98 J/s (3) 49 J/s (4) zero

41. An engineer claims to have made an engine delivering 10kW power with fuel consumption of 1 g/s. The calorific value of fuel is 2 kcal/g. This claim is
(1) valid (2) invalid (3) depends on engine design (4) dependent on load

42. A body projected vertically from the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest
(1) at the highest position of the body
(2) at the instant just before the body hits the earth
(3) it remains constant all through
(4) at the instant just after the body is projected

43. A 10 m long iron chain of linear mass density 0.8 kg m^{-1} is hanging freely from a rigid support. If g = 10 ms^{-2}, then the power required to left the chain upto the point of support in 10 second

(1) 10 W (2) 20W (3) 30 W (4) 40 W

44. A force of $2\hat{i}+3\hat{j}+4\hat{k}$ N acts on a body for 4 second, produces a displacement of $(3\hat{i}+4\hat{j}+5\hat{k})m$. The power used is

(1) 9.5 *W* (2) 7.5 *W* (3) 6.5 *W* (4) 4.5 *W*

45. An elevator of total mass (elevator + passenger) 1800 kg is moving up with a constant speed of 2 m/s. A friction of 4000 N opposes its motion. Determine the approximate power delivered by the motor to the elevator (g = 10 m/s^2)

(1) 59 hp (2) 22 hp (3) 34 hp (4) 44 hp

46. A car of mass *m* is driven with acceleration *a* along a straight level road against a constant external resistive force *R*. When the velocity of the car is *v*, the rate at which the engine of the car is doing work will be

(1) Rv (2) mav (3) $(R + ma)v$ (4) $(ma - R)v$

47. An engine is hauling a train of mass *M* kg on a level track at a constant speed *v* m/s. The resistance due to friction is *f* N/kg. What extra power must the engine develop to maintain the speed up a gradient of *h* in s

(1) $\frac{Mghv}{s}$ (2) $\frac{Mghs}{v}$ (3) $Mghvs$ (4) zero

48. An automobile moves under the action of a constant power supplied by its engine, it follows that

(1) The driving force and velocity, both are constant

(2) The driving force is constant but not the velocity

(3) The velocity is constant but not the driving force

(4) Both driving force as well as velocity vary

49. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of energy. How much power is generated by the turbine? (g = 10 m/s^2)

(1) 0.9 kW (2) 0.4 kW (3) 0.3 kW (4) 0.6 kW

50. A car of mass m starts from rest and accelerates so that the instantaneous power delivered to the car has a constant magnitude r_0. The instantaneous velocity of this car is proportional of

(1) t^2 (2) $t^{1/2}$ (3) $t^{-1/2}$ (4) $\frac{t}{\sqrt{m}}$

51. If a machine gun fires n bullets per second each with kinetic energy K, then the power of the machine gun is

(1) nK^2 (2) $\frac{K}{n}$ (3) n^2K (4) nK

Topic 4: Collisions

52. A body of mass m moving with velocity v makes a head on elastic collision with another body of mass 2m which in initially at rest. The loss of kinetic energy of the colliding body (mass m) is

(1) $\frac{1}{2}$ of its initial kinetic energy (2) $\frac{1}{9}$ of its initial kinetic energy

(3) $\frac{8}{9}$ of its initial kinetic energy (4) $\frac{1}{4}$ of its initial kinetic energy

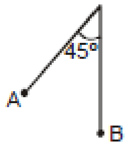
53. Two solid rubber balls A and B having masses 200 & 400 gm respectively are moving in opposite direction with velocity of A equal to 0.3 m/sec. After collision the two balls come to rest when the velocity of B is

(1) 0.15 m/sec (2) 1.5 m/sec (3) –0.15 m/sec (4) None of these

54. A body of mass m moving with velocity 3 km/h collides with a body of mass 2 m at rest. Now the coalesced mass starts to move with a velocity

(1) 1 km/h (2) 2 km/h (3) 3 km/h (4) 4 km/h

55. The bob A of a simple pendulum is released when the string makes an angle of 45° with the vertical. It hits another bob B of the same material and same mass kept at rest on the table. If the collision is elastic



(1) both A and B rise to the same height (2) both A and B come to rest at B
(3) both A and B move with the velocity of A (4) A comes to rest and B moves with the velocity of A

56. A sphere of mass 8m collides elastically (in one dimension) with a block of mass 2m. If the initial energy of sphere is E. What is the final energy of sphere?
(1) 0.8 E (2) 0.36 E (3) 0.08 E (4) 0.64 E

57. Hail storms are observed to strike the surface of the frozen lake at 300 with the vertical and rebound at 600 with the vertical. Assume contact to be smooth, the coefficient of restitution is

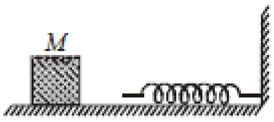
(1) $e = \frac{1}{\sqrt{3}}$ (2) $e = \frac{1}{3}$ (3) $e = \sqrt{3}$ (4) e = 3

58. A mass m moving horizontally (along the x-axis) with velocity v collides and sticks to mass of 3m moving vertically upward (along the y-axis) with velocity 2v. The final velocity of the combination is

(1) $\frac{1}{4}v\hat{i} + \frac{3}{2}v\hat{j}$ (2) $\frac{1}{3}v\hat{i} + \frac{2}{3}v\hat{j}$ (3) $\frac{2}{3}v\hat{i} + \frac{1}{3}v\hat{j}$ (4) $\frac{3}{4}v\hat{i} + \frac{1}{4}v\hat{j}$

59. A body of mass m moving with a constant velocity v hits another body of the same mass moving with the same velocity v but in the opposite direction and sticks to it. Velocity of the compound body after collision is
(1) v (2) 2v (3) zero (4) v/2

60. The block of mass *M* moving on the frictionless horizontal surface collides with the spring of spring constant *k* and compresses it by length *L*. The maximum momentum of the block after collision is



(1) $\frac{kL^2}{2M}$ (2) $\sqrt{Mk}\,L$ (3) $\frac{ML^2}{k}$ (4) zero

61. Two particles having the position $\vec{r}_1 = \left(3\hat{i} + 5\hat{j}\right)$m and $\vec{r}_2 = \left(-5\hat{i} - 3\hat{j}\right)$m move with velocities $\vec{V}_1 = \left(4\hat{i} + 3\hat{j}\right)$m/s and $\vec{V}_2 = \left(a\hat{i} + 7\hat{j}\right)$m/s. If the particles collide, then value of a must be

(1) 8 (2) 6 (3) 4 (4) 2

62. A mass of 20 kg moving with a speed of 10m/s collides with another stationary mass of 5 kg. As a result of the collision, the two masses stick together. The kinetic energy of the composite mass will be
(1) 600 (2) 800 (3) 1000 (4) 1200

63. An object of mass 2.0 kg makes an elastic collision with another object of mass M at rest and continues to move in the original direction but with one-fourth of its original speed. What is the value of M?
(1) 0.75 kg (2) 1.0 kg (3) 1.2 kg (4) None of these

64. A bullet of mass 20g and moving with 600 m/s collides with a block of mass 4 kg hanging with the string. What is velocity of bullet when it comes out of block, if block rises to height 0.2 m after collision?
(1) 200 m/s (2) 150 m/s (3) 400 m/s (4) 300 m/s

65. In case of elastic collision, at the time of impact
(1) total K.E. of colliding bodies is conserved (2) total K.E. of colliding bodies increases
(3) total K.E. of colliding bodies decreases (4) total momentum of colliding bodies decreases

66. A molecule of mass m of an ideal gas collides with the wall of a vessel with a velocity v and returns back with the same velocity. The change in linear momentum of molecule is
(1) 2 mv (2) 4 mv (3) 8 mv (4) 10 mv

67. A ball moving with velocity 2 m/s collides head on with another stationary ball of double the mass. If the coefficient of restitution is 0.5, then their velocities (in m/s) after collision will be:
(1) 0, 1 (2) 1, 1 (3) 1, 0.5 (4) 0, 2

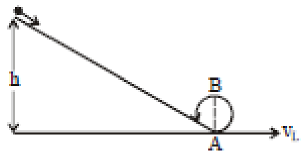
68. Consider the elastic collision of two bodies A and B of equal mass. Initially B is at rest and A moves with velocity v. After the collision
(1) the body A traces its path back with the same speed
(2) the body A comes to rest and B moves away in the direction of A's approach with the velocity v
(3) both the bodies stick together and are at rest
(4) B moves along with velocity v/2 and A retraces its path with velocity v/2.

69. A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is 6 ms^{-1}. The kinetic energy of the other mass is
(1) 324 J (2) 486 J (3) 256 J (4) 524 J

70. A tennis ball is released from height h above ground level. If the ball makes inelastic collision with the ground, to what height will it rise after third collision?
(1) he^6 (2) e^2h (3) e^3h (4) e^4h

NEET PREVIOUS YEARS QUESTIONS

1. A body initially at rest and sliding along a frictionless track from a height h (as shown in the figure) just completes a vertical circle of diameter AB = D. The height h is equal to **[2018]**



(1) $\frac{3}{2}D$ (2) D (3) $\frac{5}{4}D$ (4) $\frac{7}{5}D$

2. A moving block having mass m, collides with another stationary block having mass 4m. The lighter block comes to rest after collision. When the initial velocity of the lighter block is v, then the value of coefficient of restitution (e) will be
[2018]
(1) 0.5 (2) 0.25 (3) 0.4 (4) 0.8

3. Consider a drop of rain water having mass 1g falling from a height of 1 km. It hits the ground with a speed of 50 m/s. Take 'g' constant with a value 10 m/s^2. The work done by the (i) gravitational force and the (ii) resistive force of air is
[2017]
(1) (i) 1.25 J (ii) –8.25 J (2) (i) 100 J (ii) 8.75 J
(3) (i) 10 J (ii) – 8.75 J (4) (i) – 10 J (ii) –8.25 J

4. A particle of mass 10 g moves along a circle of radius 6.4 cm with a constant tangential acceleration. What is the magnitude of this acceleration if the kinetic energy of the particle becomes equal to 8×10^{-4} J by the end of the second revolution after the beginning of the motion ?
[2016]
(1) 0.1 m/s^2 (2) 0.15 m/s^2 (3) 0.18 m/s^2 (4) 0.2 m/s^2

5. A body of mass 1 kg begins to move under the action of a time dependent force $\vec{F} = \left(2t\hat{i} + 2t^2\hat{j}\right)N$, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y axis. What power will be developed by the force at the time t?
[2016]
(1) $(2t^2 + 3t^3)$W (2) $(2t^2 + 4t^4)$W (3) $(2t^3 + 3t^4)$ W (4) $(2t^3 + 3t^5)$W

6. A block of mass 10 kg, moving in x direction with a constant speed of 10 ms^{-1}, is subject to a retarding force F = 0.1 × J/m during its travel from x = 20 m to 30 m. Its final KE will be: **[2015]**

(1) 450 J (2) 275 J (3) 250 J (4) 475 J

7. A ball is thrown vertically downwards from a height of 20 m with an initial velocity v_0. It collides with the ground loses 50 percent of its energy in collision and rebounds to the same height. The initial velocity v_0 is : (Take $g = 10\ ms^{-2}$)
[2015 RS]
(1) 20 ms^{-1} (2) 28 ms^{-1} (3) 10 ms^{-1} (4) 14 ms^{-1}

8. The heart of man pumps 5 litres of blood through the arteries per minute at a pressure of 150 mm of mercury. If the density of mercury be $13.6 \times 10^3\ kg/m^3$ and $g = 10 m/s^2$ then the power of heart in watt is:
[2015 RS]
(1) 2.35 (2) 3.0 (3) 1.50 (4) 1.70

9. A body of mass (4m) is lying in x-y plane at rest. It suddenly explodes into three pieces. Two pieces, each of mass (m) move perpendicular to each other with equal speeds (v). The total kinetic energy generated due to explosion is :
[2014]
(1) mv^2 (2) $\frac{3}{2}\ mv^2$ (3) $2\ mv^2$ (4) $4\ mv^2$

10. Body A of mass 4m moving with speed u collides with another body B of mass 2m, at rest. The collision is head on and elastic in nature. After the collision the fraction of energy lost by the colliding body A is :
[NEET-2019]
1) $\frac{1}{9}$ 2) $\frac{8}{9}$ 3) $\frac{4}{9}$ 4) $\frac{5}{9}$

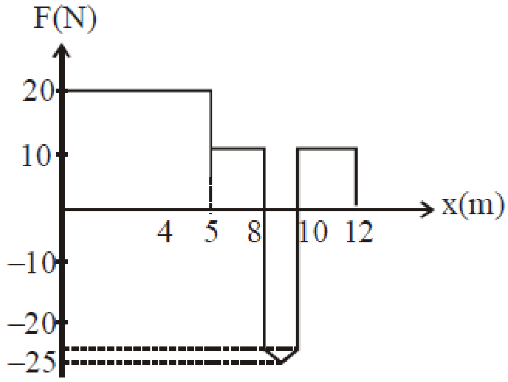
11. A mass m is attached to a thin wire and whirled in a vertical circle. The wire is most likely to break when
[NEET-2019]
(1) the mass is at the highest point (2) the wire is horizontal
(3) the mass is at the lowest point (4) inclined at an angle of 60° from vertical

12. A force F = 20 + 10y acts on a particle in y-direction where F is in newton and y in meter. Work done by this force to move the particle from y = 0 to y = 1 m is : **[NEET-2019]**
(1) 30 J (2) 5 J (3) 25 J (4) 20 J

13. An object flying in air with velocity $\left(20\hat{i}+25\hat{j}-12\hat{k}\right)$ suddenly breaks in two pieces whose masses are in the ratio 1 : 5. The smaller mass flies off with a velocity $\left(100\hat{i}+35\hat{j}+8\hat{k}\right)$. The velocity of the larger piece will be :- **[NEET – 2019 (ODISSA)]**
1) $4\hat{i}+23\hat{j}-16\hat{k}$ 2) $-100\hat{i}-35\hat{j}-8\hat{k}$ 3) $20\hat{i}+15\hat{j}-80\hat{k}$ 4) $-20\hat{i}-15\hat{j}-80\hat{k}$

14. A particle of mass 5 m at rest suddenly breaks on its own into three fragments. Two fragments of mass m each move along mutually perpendicular direction with speed v each. The energy released during the process is : **[NEET – 2019 (ODISSA)]**
(1) $\frac{3}{5}mv^2$ (2) $\frac{5}{3}mv^2$ (3) $\frac{3}{2}mv^2$ (4) $\frac{4}{3}mv^3$

15. An object of mass 500g, initially at rest acted upon by a variable force, whose X component varies with x in the manner shown. The velocities of the object at point X = 8 m and X =12 m, would be the respective values of (nearly) **[NEET – 2019 (ODISSA)]**



(1) 18 m/s and 24.4 m/s (2) 23 m/s and 24.4 m/s
(3) 23 m/s and 20.6 m/s (4) 18 m/s and 20.6 m/s

16. A point mass 'm' is moved in a vertical circle of radius 'r' with the help of a string. The velocity of the mass is $\sqrt{7gr}$ at the lowest point. The tension in the string at the lowest point is **NEET-2020(COVID-19)**
(1) 6 mg (2) 7 mg (3) 8 mg (4) 1 mg

17. The energy required to break one bond in DNA is $10^{-20}\,J$. This value in eV is nearly: **[NEET-2020]**
1) 0.006 2) 6 3) 0.6 4) 0.06

18. Water falls from a height of 60 m at the rate of 15 kg/s to operate a turbine. The losses due to frictional force are 10% of the input energy. How much power is generated by the turbine? (g = 10 m/s^2) **[NEET-2021]**
1) 8.1 kW 2)12.3 kW 3) 7.0 kW 4) 10.2 kW

19. A particle is released from height S from the surface of the Earth. At a certain height its kinetic energy is three times its potential energy. The height from the surface of earth and the speed of the particle at that instant are respectively: **[NEET-2021]**
1) $\frac{S}{4},\sqrt{\frac{3gS}{2}}$ 2) $\frac{S}{4},\frac{\sqrt{3gS}}{2}$ 3) $\frac{S}{4},\sqrt{\frac{3gS}{2}}$ 4) $\frac{S}{4},\frac{3gS}{2}$

NCERT LINE BY LINE QUESTIONS – ANSWERS

1) 2	2) 2	3) 3	4) 1	5) 1	6) 3	7) 4	8) 2	9) 3	10) 1
11) 2	12) 3	13) 2	14) 21	15) 1	16) 3	17) 3	18) 1	19) 2	20) 3

NCERT BASED PRACTICE QUESTIONS – ANSWERS

1) a	2) a	3) c	4) b	5) d	6) b	7) b	8) a	9) b	10) c
11) a	12) b	13) d	14) a	15) c	16) a	17) c	18) a	19) b	20) c
21) b	22) a	23) b	24) b	25) a	26) b	27) c	28) c	29) d	30) b
31) d	32) a	33) b	34) c	35) d	36) c	37) a	38) b	39) c	40) b

b

TOPIC WISE PRACTICE QUESTIONS - ANSWERS

1) 2	2) 1	3) 3	4) 4	5) 1	6) 3	7) 3	8) 3	9) 4	10) 4
11) 3	12) 2	13) 3	14) 1	15) 2	16) 1	17) 2	18) 3	19) 3	20) 1
21) 4	22) 3	23) 4	24) 4	25) 4	26) 4	27) 1	28) 2	29) 4	30) 3
31) 1	32) 2	33) 2	34) 4	35) 2	36) 1	37) 1	38) 4	39) 3	40) 4

41)	2	42)	2	43)	4	44)	1	45)	4	46)	3	47)	3	48)	4	49)	1	50)	2
51)	4	52)	3	53)	1	54)	1	55)	4	56)	2	57)	2	58)	1	59)	3	60)	2
61)	1	62)	2	63)	4	64)	1	65)	3	66)	1	67)	1	68)	2	69)	2	70)	1

NEET PREVIOUS YEARS QUESTIONS-ANSWERS

1)	3	2)	2	3)	3	4)	1	5)	4	6)	4	7)	1	8)	4	9)	2	10)	2
11)	3	12)	3	13)	1	14)	4	15)	3	16)	3	17)	4	18)	1	19)	3		

TOPIC WISE PRACTICE QUESTIONS - SOLUTIONS

1. **(2)** $W=\vec{F}.\vec{x}=\left(5\hat{i}+3j+2\hat{k}\right).\left(2i-\hat{j}\right)=10-3=7\,\text{joules}$

2. **(1)** $\vec{F}=-5\hat{i}+9\cos 60\hat{i}+9\sin 60^0\hat{j}-3\hat{j}$

$$=-5\hat{i}+\frac{9}{2}\hat{i}+\frac{9\sqrt{3}}{2}\hat{j}-3\hat{j}=-\frac{\hat{i}}{2}+\left(\frac{9\sqrt{3}}{2}-3\right)\hat{j}$$

$\vec{s}=-3\hat{i}$

$$W=\vec{F}.\vec{s}=\left[-\frac{\hat{i}}{2}+\left(\frac{9\sqrt{3}}{2}-3\right)\hat{j}\right]\left(-3\hat{i}\right)=1.5J$$

3. **(3)** We know work done in displacing the object is equal to the product of the force applied on the object and the distance travelled by it in the direction of force applied. Let us apply this concept to solve the problem.

4. **(4)** Speed will not increase when force is perpendicular to displacement i.e., $\hat{F}\perp\hat{d}$

5. **(1)** $x=3t-4t^2+t^3$

$$\frac{dx}{dt}=3-8t+3t^2$$

$$\text{Acceleration}=\frac{d^2x}{dt^2}=-8+6t$$

Acceleration after 4 sec = –8 + 6 × 4 = 16 ms^{-2}

Displacement in 4 sec = 3 ×4 – 4 × 4^2 + 4^3 = 12 m

∴ Work = Force × displacement = Mass × acc. × disp.

= 3 × 10^{-3} × 16 × 12 = 576 mJ

6. **(3)** $W=\vec{F}.\vec{s}=\left(5\hat{i}+2\hat{j}\right).\left(2\hat{i}+3\hat{j}\right)=10+6=16J$

7. **(3)** $W=Fs\cos\theta=10\times2\cos60^0=10J$

8. **(3)** $W=Fs\cos\theta,\ \cos\theta=\frac{W}{Fs}=\frac{25}{5\times10}=\frac{1}{2},\theta=60^0$

9. **(4)** Though an equal and opposite force acts on the road but since road does not undergo any displacement, hence no work is done on the road

10. **(4)** Given : $\vec{F}=3\hat{i}+\hat{j}$

$\vec{r}_1=\left(2\hat{i}+\hat{k}\right).\vec{r}_2=\left(4\hat{i}+3\hat{j}-\hat{k}\right)$

$\vec{r}=\vec{r}_2-\vec{r}_1=\left(4\hat{i}+3\hat{j}-\hat{k}\right)-\left(2\hat{i}+\hat{k}\right)$

or $\vec{r}=2\hat{i}+3\hat{j}-2\hat{k}$

So work done by the given force $W=\vec{F}.\vec{r}$

$= (3\hat{i}+\hat{j}).(2\hat{i}+3\hat{j}-2\hat{k}) = 6+3 = 9J$

11. **(3)** Here, m = 4 × 10^{-3} kg

x = $4t^2$ + t

$\therefore \frac{dx}{dt} = 8t+1 \frac{d^2x}{dt^2} = 8$

Work done, $W = \int f\,dx = \int m\frac{d^2x}{dt^2}\left(\frac{dx}{dt}\right)dt$

$= \int_0^2 (4\times10^{-3})(8)(8t+1)dt$

$= 32\times10^{-3}\int_0^2 (8t+1)dt = 32\times10^{-3}\left[\frac{8t^2}{2}+t\right]_0^2$

$= 32\times10^{-3}\left[4(2)^2+2-0\right] = 576\,mJ$

12. **(2)** conservative force path independent

13. **(3)** W = area of $F - x$ graph

= area of Δ + area of rectangle + area of Δ

$= \frac{5\times3}{2}+10\times3+\frac{5\times3}{2} = 45J$

14. **(1)** $W = \vec{F}.(\vec{r}_2-\vec{r}_1) = (4\hat{i}+\hat{j}+3\hat{k})(11\hat{i}+11\hat{j}+15\hat{k})$

15. (2) Horizontal component of applied force $= (\sqrt{3}\times10^3)\times\cos 30^0$

$= \sqrt{3}\times10^3\times\frac{\sqrt{3}}{2} = \frac{3}{2}\times10^3\,N$

Work done = F.s

$= \frac{3}{2}\times10^3\times10 = 15\times10^3\,J = 15kJ$

16. **(1)** $W_1 = \frac{1}{2}\times5\times10^3(0.05)^2 \Rightarrow W_2 = \frac{1}{2}\times5\times10^3(0.10)^2$

$\therefore \Delta W = \frac{1}{2}\times5\times10^3\times0.15\times0.05 = 18.75J$

17. **(2)** Energy required = mgh

In both cases, h is the same. Hence energy both is the same.

18. **(3)** Weight Mg moves the centre of gravity of the spring through a distance

$\frac{(0+\ell)}{2} = \ell/2$

$\therefore$ Mechanical energy stored = Work done = Mg ℓ/2.

19. **(3)** Initial momentum (p_1) = p; Final momentum (p_2) = 1.5 p and initial kinetic energy (K_1) = K.

Kinetic energy $(K) = \frac{p^2}{2m} \propto p^2$

or $\frac{K_1}{K_2} = \left(\frac{p_1}{p_2}\right)^2 = \left(\frac{p}{1.5p}\right)^2 = \frac{1}{2.25}$ or $K_2 = 2.25K$

Therefore, increase in kinetic energy is 2.25 $K - K$ = 1.25 K or 125%.

20. **(1)** From $F = -\frac{dU}{dx}$

$dU = -Fdx$

$$U=\int_0^{u(x)} dU=-\int_0^x Fdx$$

$$=-\int_0^c kxdx\ ;\ U=-\frac{kx^2}{2}$$

As, U(0)=0,αx^2 (where α is a constant) and U are negative.

21. **(4)** Kinetic energy of ball when reaching the ground = mgh = mg × 10
Kinetic energy after the impact

$$=\frac{60}{100}\times mg\times 10=6mg$$

If the ball rises to a height h, then mgh = 6 mg.
Hence, h = 6 m.

22. **(3)** The uniform acceleration is $a=\frac{1-0}{15}=\frac{1}{15}ms^{-2}$

Let v be the velocity at kinetic energy $\frac{2}{9}J$

therefore $\frac{1}{2}\times 1\times v^2=\frac{2}{9}$ or $v=\frac{2}{3}ms^{-1}$

Using v = u + at

$$\frac{2}{3}=0+\frac{1}{15}\times t\Rightarrow t=10s$$

23. **(4)** $F=-\frac{dU}{dy}=b-2ay$

24. **(4)** Centripetal force $=\frac{mv^2}{R}=\left(\frac{1}{2}mv^2\right)\frac{2}{R}=\frac{2K}{R}=\frac{2aS}{R}$

25. **(4)** Work done on the body is gain in the kinetic energy.
Acceleration of the body is a = V/T.

Velocity acquired in time t is v = at $=\frac{V}{T}t$

K.E. acquired $\propto v^2$. That is work done $\propto\frac{V^2t^2}{T^2}$

26. (4) Let $=\frac{m}{\ell}$ (linear mass density)

Velocity of dx element and a distance x from rigid support is $v^{|}=\frac{vx}{\ell}$

Now mass of thickness (dx)**=ωdx=dm**

KE of particle of thickness $(dx)=\frac{1}{2}dmv^2$

$$K.E.=\int_0^1\frac{1}{2}\omega dx\left(\frac{vx}{L}\right)^2\quad=\frac{1}{2}\frac{m}{L}\frac{v^2}{L^2}\int_0^L x^2dx=\frac{mv^2}{2L^3}\times\left[\frac{x^3}{3}\right]_0^L=\frac{mv^2}{6}$$

27. **(1)** Given : k_A = 300N/m, k_B = 400N / m
Let when the combination of springs is compressed by force F. Spring A is compressed by x. Therefore compression in spring B
x_B = (8.75- x) cm
F = 300× x = 400(8.75- x)
Solving we get, x = 5 cm x_B = 8.75- 5 = 3.75cm

$$\frac{E_A}{E_B}=\frac{\frac{1}{2}k_A(x_A)^2}{\frac{1}{2}k_B(x_B)^2}=\frac{300\times(5)^2}{400\times(3.75)^2}=\frac{4}{3}$$

28. **(2)** According to principle of conservation of energy
Loss in potential energy = Gain in kinetic energy

$$\Rightarrow mgh=\frac{1}{2}mv^2 \Rightarrow v=\sqrt{2gh}$$

If h_1 and h_2 are initial and final heights, then

$$v_1=\sqrt{2gh_1}, v_2=\sqrt{2gh_2}$$

Loss in velocity

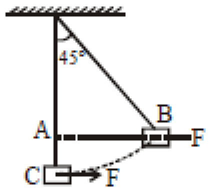
$$\Delta v=v_1-v_2=\sqrt{2gh_1}-\sqrt{2gh_2}$$

$\therefore$ Fractional loss in velocity

$$\frac{\Delta v}{v_1}=\frac{\sqrt{2gh_1}-\sqrt{2gh_2}}{\sqrt{2gh_1}}=1-\sqrt{\frac{h_2}{h_1}}$$

$$=1-\sqrt{\frac{1.8}{5}}=1-\sqrt{0.36}=1-0.6=0.4=\frac{2}{5}$$

29. **(4)** Work done by force (applied) + Work done by gravitational force = change in kinetic energy

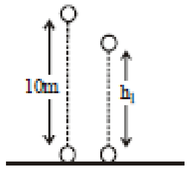


$$\Rightarrow F\times AB-Mg\,AC=0$$

$$\Rightarrow F=Mg\left(\frac{AC}{AB}\right)=MG\left[\frac{1-\frac{1}{\sqrt{2}}}{\frac{1}{\sqrt{2}}}\right]$$

$$=Mg\left(\sqrt{2}-1\right)$$

30. **(3)** Just before impact, energy
E = mgh = 10mg .. (1)
Just after impact



$$E_1=mgh-\frac{25}{100}mgh=0.75mgh$$

Hence, $mgh_1 = E_1$ (from given figure)
$mgh_1 = 0.75$ mg (10) ; $h_1 = 7.5$m

31. **(1)** In the device when free end of the string is pulled by ℓ, the block will rise by $\ell/2$. So increase in potential energy $U = mg\ell/2$.

32. **(2)** In this case, $P=\dfrac{mgh+\frac{1}{2}mv^2}{t}$

$$\Rightarrow P = \frac{m}{t}\left[gh + \frac{v^2}{2}\right]$$

$$\Rightarrow P = \frac{10}{1}\left[10\times10 + \frac{10\times10}{2}\right]W = 1500W$$

33. **(2)** $P = \frac{W}{t}$

$W = Mgh = M \times 10 \times 10 = 100\ M$ and $t = 60$ s.
This gives, $M = 1200$ kg
Its volume = 1200 litre as 1 litre of water contains 1 kg of its mass.

34. **(4)** From $v = u + at$, $v_1 = 0 + at_1$

$\therefore a = \frac{v_1}{t_1}$ $\qquad F = ma = mv_1 / t_1$

Velocity acquired in t sec $= at = \frac{v_1}{t_1}t$

Power $= F \times v = \frac{mv_1}{t_1} \times \frac{v_1 t}{t_1} = \frac{mv_1^2 t}{t_1^2}$

35. **(2)** The work is done against gravity so it is equal to the change in potential energy. $W = E_p = mgh$
For a fixed height, work is proportional to weight lifted.
Since Johnny weighs twice as much as Jane he works twice as hard to get up the hill.
Power is work done per unit time. For Johnny this is $W/\Delta t$. Jane did half the work in half the time, $(1/2\ W)/(1/2\,\Delta t) = W/\Delta t$ which is the same power delivered by Johnny.

36. **(1)** Given, Velocity=v_1 force=F
We know that work done is equal to the product of force and displacement
$W = f \times x$
Divided by t in both sides then we get,

$\frac{w}{t} = \frac{fx}{t} \Rightarrow \frac{x}{t} = v\ \&\ \frac{w}{t} = p$

Therefore p=fv

37. **(1)** $P = Fv = F \times \frac{s}{t} = 40 \times \frac{30}{60} = 20W$

38. **(4)** m : mass per unit length

$\therefore$ rate of mass leaving the hose per sec $= \frac{mx}{t} = mv$

Rate of K.E. $= \frac{1}{2}(mv)v^2 = \frac{1}{2}mv^3$

39. **(3)** Given $t_1 = 2s, t_2 = 4s$ and $h_1 = h_2 = h$

As $P_A = \frac{mgh_1}{t_1}$ -------------(i)

and $P_B = \frac{mgh_2}{t_2}$

$$\Rightarrow P_A : P_B = \frac{mgh_1/t_1}{mgh_2/t_2} = \left(\frac{h_1}{h_2}\right)\left(\frac{t_2}{t_1}\right) = \frac{t_2}{t_1} = \frac{4}{2} = \frac{2}{1}$$

$$\Rightarrow P_A : P_B = 2:1$$

40. **(4)** The power of body is given by $= \vec{F}.\vec{v}$ as the body is moving in circular path, centripetal force and

velocity are at 90°, or power = 0.

41. **(2)** P = 10 kW = 10000 W
Fuel consumption = 1g/s
Calorific value = 2 kcal/g
$\therefore$ Energy produced = 2 kcal/s
Input power
= 2 kcal/s = 2000 cal/s = 2000 × 4.18 J/s = 8.4 k W
$\therefore$ This claim is invalid.

42. **(2)** the expression for acceleration due to gravity is
$g = \frac{GMr}{R^2}$, if r < R, increasing as r increases.
$g = \frac{GMr}{r^2}$, if r > R, decreases as r increases.
$g = \frac{GMr}{R^2}$, if r = R
so the expression will have highest value at surface. i.e. r=R.

43. **(4)** m $= 10 \times 0.8$kg = 8kg
height of iron chain = 5m
$$P = \frac{mgh}{t} = \frac{8 \times 10 \times 5}{10} W = 40W$$

44. **(1)** $W = \vec{F}.\vec{s} = \left(2\hat{i} + 3\hat{j} + 4\hat{k}\right).\left(3\hat{i} + 4\hat{j} + 5\hat{k}\right)$
$= 2 \times 3 + 3 \times 4 + 4 \times 5 = 38J$
$$P = \frac{W}{t} = \frac{38}{4} = 9.5W$$

45. **(4)** $P = Fv$ = (1800 g + 4000) × 2 = 44000 W.

46. **(3)** If F is the force exerted by the engine of the car, then
$F - R = ma$; $\therefore F = \left(R + ma\right)$
The power $P = Fv = \left(R + ma\right)v$

47. **(3)** Power = force × speed
additional resistive force due to friction = f × M
Hence additional power is f × M × v

48. **(4)** For a straight line motion, $P = \vec{F}.\vec{ds}$ reduces to
$P = Fv \quad \left[\because \vec{F} \uparrow\uparrow \vec{v}\right]$
Now since P = constant $\neq 0$
$\therefore F \neq 0$ and $v \neq 0$
From $F \neq 0 \Rightarrow m\frac{dv}{dt} \neq 0$
$\therefore$ v is variable
Further as, $F = \frac{P}{v}$; so $F \propto \frac{1}{v}$
Therefore, F also changes

49. **(1)** Given, h = 60m, g = 10 ms^{-2},
Rate of flow of water = 15 kg/s
$\therefore$ Power of the falling water
= 15 kgs^{-1} × 10 ms^{-2} × 60 m = 9000 watt.
Loss in energy due to friction
$$= 9000 \times \frac{10}{100} = 900 \text{ watt}$$

50. **(2)** Constant power of car $P_0 = F.V = ma.v$

51. **(4)** The power of the machine gun

$$= \frac{\text{total work done}}{\text{time}} = \frac{n.\frac{1}{2}mv^2}{t}$$

$$= n.\frac{1}{2}\frac{mv^2}{t}\left(\because K = \frac{1}{2}mv^2, t = 1s\right)$$

$\therefore$ The power of the machine gun = nK

52. **(3)** Fraction of energy transferred $= = \frac{4\times 2}{(1+2)^2} = \frac{8}{9}$

53. **(1)** $m_1 = 0.2$ kg, $m_2 = 0.4$ kg, $v_1 = 0.3$m/ s, v_2 = ?

Applying law of conservation of momentum

$$m_1v_1 - m_2v_2 = \frac{0.2\times 0.3}{0.4} = 0.15\,m/s$$

54. **(1)** Applying law of conservation of momentum,

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v \text{ or } m_1u_1 = (m_1 + m_2)v \qquad (\because u_2 = 0)$$

$$\Rightarrow m\frac{(3\times 1000)}{3600} = 3m(v) \Rightarrow v = \frac{1000}{3600}m/s = 1km/hr$$

55. (4) As bob B is of same material and same mass as the bob A, therefore, on elastic collision, their velocities are exchanged.

Bob A comes to rest and B moves with the velocity of A.

We can prove this by momentum conservation and e=1.

$$e = \frac{\text{Speed of separation}}{\text{Speed of approach}} = \frac{v_2 - v_1}{u_1} = 1$$

$$\Rightarrow v_2 - v_1 = u_1\text{------------}(1)$$

$$mu_1 = mv_1 + mv_2$$

$$\Rightarrow v_2 + v_1 = u_1\text{--------}(2)$$

Using (1) and (2), we get,

$v_1 = 0,\ v_2 = u_1$

56. **(2)** For elastic collision in one dimension

$$v_1 = \frac{2m_2u_2}{m_1 + m_2} + \frac{(m_1 - m_2)u_1}{(m_1 + m_2)}$$

As mass 2m, is at rest, So $u_2 = 0$

$$\Rightarrow v_1 = \frac{(8m - 2m)}{8m + 2m} = \frac{3}{5}u$$

Final energy of sphere = $(K.E.)_f$

$$= \frac{1}{2}(8m)\left(\frac{3u}{5}\right)^2 = \frac{1}{2}(8m)u^2\times\left(\frac{3}{5}\right)^2 = \frac{9}{25}E = 0.36E$$

57. **(2)** Components of velocity before and after collision parallel to the plane are equal, So

v sin 60° = u sin 30° ....(1)

Components of velocity normal to the plane are related to each other

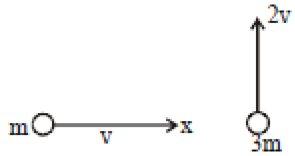
v cos 60° = e u (cos 30°) ....(2)

$$\Rightarrow \cot 60^0 = e\cot 30^0 \Rightarrow e = \frac{\cot 60^0}{\cot 30^0} \quad \Rightarrow e = \frac{\frac{1}{\sqrt{3}}}{\sqrt{3}} \Rightarrow e = \frac{1}{3}$$

58. **(1)** As the two masses stick together after collision, hence it is inelastic collision. Therefore, only momentum is conserved.

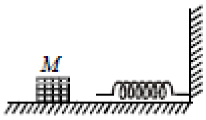
$$\therefore mv\hat{i} + 3m(2v)\hat{j} = (4m)\vec{v}$$

$$\vec{v} = \frac{v}{4}\hat{i} + \frac{6}{4}v\hat{j} = \frac{v}{4}\hat{i} + \frac{3}{2}v\hat{j}$$



59. **(3)** Initial momentum of the system = mv-mv = 0
As body sticks together \ final momentum = 2mv
By conservation of momentum 2mv = 0 \v = 0

60. **(2)** $\frac{1}{2}Mv^2 = \frac{1}{2}kL^2$



$$\Rightarrow v = \sqrt{\frac{k}{M}}.L$$

$$\text{Momentum } = M\times v = M\times\sqrt{\frac{k}{M}}.L = \sqrt{kM}.L$$

61. **(1)** For collision, their position vectors at t=2 should be same. Hence

$$\left(3\hat{i}+5\hat{j}\right)+2\left(4\hat{i}+3\hat{j}\right)=\left(-5\hat{i}-3\hat{j}\right)+2\left(\alpha\hat{i}+7\hat{j}\right)$$

$$\Rightarrow\left(11\hat{i}+11\hat{j}\right)=\left[(-5+2\alpha)\hat{i}+11\hat{j}\right]\Rightarrow\alpha=8$$

62. **(2)** $m_1v_1 + m_2v_2 = (m_1+m_2)v_{sys}$

$$20\times10+5\times0=(20+5)v_{sys}\Rightarrow v_{sys}=8m/s$$

$$\text{K. E. of composite mass} = \frac{1}{2}(20+5)\times(8)^2 = 800J$$

63. **(4)** For the object of mass 2.0 kg.

$$\frac{\Delta k}{k} = \frac{k - k/4}{k} = \frac{3}{4}$$

Kinetic energy transferred

$$\frac{\Delta k}{k} = \frac{4m_1m_2}{(m_1+m_2)^2}$$

Here, m_1 = 2.0 kg, m_2 = M

$$\therefore \frac{3}{4} = \frac{4\times2M}{(2+M)^2} \Rightarrow M = \frac{2}{3}\text{kg or } 6\text{kg}$$

64. **(1)** Initial, $\text{K.E.} = \frac{1}{2}mv^2 = \frac{1}{2}\times\frac{20}{1000}\times600\times600 = 3600J$

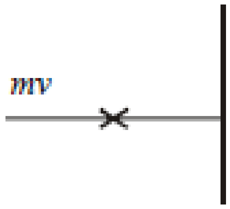
Change in K.E. = P.E.

$$\frac{1}{2}m\left(v^2 - v'^2\right) = mgh$$

$$\Rightarrow 3600 - \frac{1}{2}\times\frac{20}{1000}\times v_1^2 = 4\times 10\times 80 \Rightarrow v_1 = 200\,m/s$$

65. **(3)** total K.E. of colliding bodies decreases

66. **(1)**



Initial momentum = mv
Final momentum = $m(-v)$
change in momentum
$= mv - m(-v) = 2mv$

67. (1) Let mass of first ball be m i.e. $m_1=m$

Mass of second ball $m_2=2m$

Velocity of first ball before collision $u_1=2$ m/s

Velocity of second ball before collision $u_2=0$ m/s

Given : $e=0.5$

So, velocity of first ball after collision $v_1 = \dfrac{(m_1 - em_2)u_1 + (1+e)m_2u_2}{m_1+m_2}$

$$\therefore v_1 = \frac{[m - 0.5(2m)](2) + (1+0.5)(2m)(0)}{m+2m} = 0\,m/s$$

Velocity of second ball after collision $v_2 = \dfrac{(m_2 - em_1)u_2 + (1+e)m_1u_1}{m_1+m_2}$

$$\therefore v_2 = \frac{[2m - 0.5m](0) + (1+0.5)(m)(2)}{m+2m} = 1\,m/s$$

68. **(2)** When two equal mass collide elastically then velocities get interchange

69. **(2)** From conservation of linear momentum $m_1v_1 + m_2v_2 = 0$

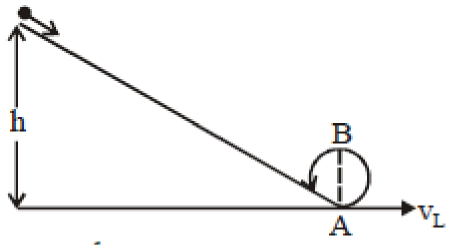
$$v_2 = \left(\frac{-m_1}{m_2}\right)v_1 = \left(\frac{-18}{12}\right)6 = -9ms^{-1}$$

$$K.E = \frac{1}{2}m_2v_2^2 = \frac{1}{2}\times 12\times 9^2 = 486J$$

70. **(1)** $h_n = he^{2n}$, after third collision $h_3 = he^6\,[as\; n=3]$

NEET PREVIOUS YEARS QUESTIONS-EXPLANATIONS

1. **(3)** As track is frictionless, so total mechanical energy will remain constant



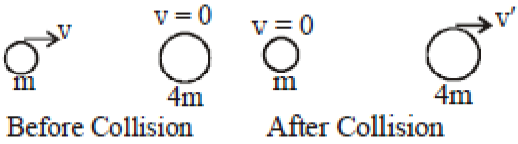
i.e., $0 + mgh = \frac{1}{2}mv_L^2 + 0$

Using $v^2 - u^2 = 2gh, h = \frac{v_L^2}{2g} (\because u = 0)$

For completing the vertical circle $v_L \geq \sqrt{5gR}$

or $h = \frac{5gR}{2g} = \frac{5}{2}R = \frac{5}{4}D$

2. **(2)**



According to law of conservation of linear momentum,

$mv + 4m \times 0 = 4mv' + 0 \Rightarrow v' = \frac{v}{4}$

Coefficient of restitution,

$e = \frac{\text{Relative velocity of separation}}{\text{Relative velocity of approach}}$

$= \frac{\frac{v}{4}}{v}$ or $e = \frac{1}{4} = 0.25$

3. **(1)**

4. (1) Given: Mass of particle, $M = 10g = \frac{10}{1000}kg$

radius of circle R = 6.4 cm

Kinetic energy E of particle = 8×10^{-4}J

acceleration a_t = ?

$\frac{1}{2}mv^2 = E \Rightarrow \frac{1}{2}\left(\frac{10}{1000}\right)v^2 = 8 \times 10^{-4}$

$\Rightarrow v^2 = 16 \times 10^{-2}$

$\Rightarrow v = 4 \times 10^{-1} = 0.4 m/s$

Now, using

$v^2 = u^2 + 2a_t s (s = 4\pi R)$

$(0.4)^2 = 0^2 + 2a_t\left(4 \times \frac{22}{7} \times \frac{6.4}{100}\right)$

$\Rightarrow a_t = (0.4)^2 \times \frac{7 \times 100}{8 \times 22 \times 6.4} = 0.1 m/s^2$

5. **(4)** Given force $\vec{F} = 2t\hat{i} + 3t^2\hat{j}$

According to Newton's second law of motion,

$m\frac{d\vec{v}}{dt} = 2t\hat{i} + 3t^2\hat{j}$ (m = 1kg)

$\Rightarrow \int_0^{\vec{v}} d\vec{v} = \int_0^t (2t\hat{i} + 3t^2\hat{j})dt$

$\Rightarrow \vec{v} = t^2\hat{i} + t^3\hat{j}$

Power $P = \vec{F}.\vec{v} (2t\hat{i} + 3t^2\hat{j}).(t^2\hat{i} + t^3\hat{j})$

$= (2t^3 + 3t^2)W$

6. **(4)** From, F = ma

$$a=\frac{F}{m}=\frac{0.1x}{10}=0.01x=V\frac{dV}{dx}$$

So, $\int_{v_1}^{v_2} vdV=\int_{20}^{30}\frac{x}{100}dx$

$$-\frac{V^2}{2}\Big|_{V_1}^{V_2}=\frac{x^2}{200}\Big|_{20}^{30}=\frac{30\times30}{200}-\frac{20\times20}{200}$$

$$=4.5-2=2.5$$

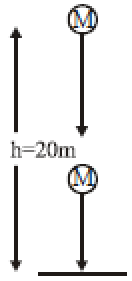
$$\frac{1}{2}m\left(V_2^2-V_1^2\right)=10\times2.5J=-25J$$

Final K.E.

$$=\frac{1}{2}mv_2^2=\frac{1}{2}mv_1^2-25=\frac{1}{2}\times10\times10\times10-25$$

$$=500-25=475J$$

7. **(1)** When ball collides with the ground it loses its 50% of energy



$$\therefore\frac{KE_f}{KE_i}=\frac{1}{2}\Rightarrow\frac{\frac{1}{2}mV_f^2}{\frac{1}{2}mV_i^2}=\frac{1}{2}\text{ or }\frac{V_f}{V_i}=\frac{1}{\sqrt{2}}$$

$$\text{or }\frac{\sqrt{2gh}}{\sqrt{V_0^2+2gh}}=\frac{1}{\sqrt{2}}\text{ or }4gh=V_0^2+2gh$$

$$\therefore V_0=20ms^{-1}$$

8. **(4)** Power $\vec{F}.\vec{V}=PA\vec{V}=\rho ghAV$

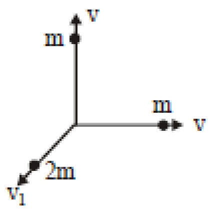
$$\left[\because P=\frac{F}{A}\text{ and }P=\rho gh\right]$$

$$=13.6\times10^3\times10\times150\times10^{-3}\times0.5\times10^{-3}/60$$

$$=\frac{102}{60}=1.70\text{ watt}$$

9. **(2)** By conservation of linear momentum

$$2mv_1=\sqrt{2}mv\Rightarrow v_1=\frac{v}{\sqrt{2}}$$

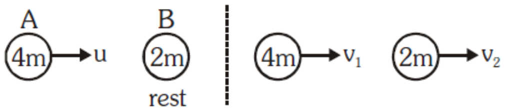


As two masses of each of mass m move perpendicular to each other.

Total KE generated

$$=\frac{1}{2}mv^2+\frac{1}{2}mv^2+\frac{1}{2}(2m)v_1^2$$

$$=mv^2+\frac{mv^2}{2}=\frac{3}{2}mv^2$$

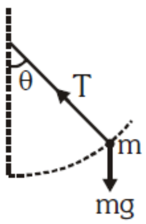
10. 

$$v_1=\frac{4m-2m}{4m+2m}u=\frac{2mu}{6m}=\frac{u}{3}$$

$$\text{Fraction of energy lost}=\frac{\frac{1}{2}(4m)u^2-\frac{1}{2}(4m)\left(\frac{u}{3}\right)^2}{\frac{1}{2}(4m)u^2}$$

$$=1-\frac{1}{9}=\frac{8}{9}$$

11. T . mg cos θ=mv^2/R



T will be maximum when $\theta = 0°$,

When mass is at lowest point.

12.

$$W=\int_{y_1}^{y_2}F\,dy$$

$$\Rightarrow W=\int_0^1(20+10y)\,dy$$

$$\Rightarrow W=20[y]_0^1+10\left[\frac{y^2}{2}\right]_0^1$$

$$\Rightarrow W=25\text{ J}$$

13. $\frac{m_1}{m_2}=\frac{1}{5};m_1+m_2=m$

$$m_1=\frac{m}{6};m_2=\frac{5m}{6}$$

$$m_1v_1+m_2v_2=mv$$

$$\frac{m}{6}\left(100\hat{i}+35\hat{j}+8\hat{k}\right)+\frac{5m}{6}v_2=m\left(20\hat{i}+25\hat{j}-12\hat{k}\right)$$

$$5v_2=\left(6\times20\hat{i}-100\hat{i}+(25\times6)\hat{j}-35\hat{j}-12\times6\hat{k}-8\hat{k}\right)$$

$$v_2=4\hat{i}+23\hat{j}-16\hat{k}$$

14. Energy released $=\frac{1}{2}mv^2+\frac{1}{2}mv^2+\frac{1}{2}3m\left(\sqrt{2}\frac{v}{3}\right)^2$

$=mv^2+\frac{2}{2}\frac{3mv^2}{9}=\frac{4mv^2}{3}$

15. From work energy theorem

$\Delta K.E.=\text{work}$ = area under F-x graph

From $x=0$ to $x=8m$

$\frac{1}{2}mv^2=(5\times20)+(3\times10)$

$\therefore\frac{1}{2}mv^2=100+30$

$\therefore v^2=520$

$\therefore v=\sqrt{520}=22.8\approx23\,m/s$

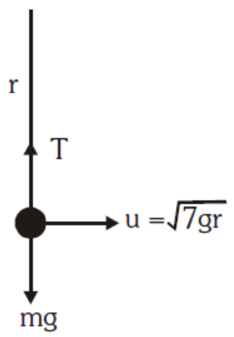
Similarly, from x =0 to x = 12m

$\frac{1}{2}mv^2=100+30-47.5+20$

$\therefore\frac{1}{2}mv^2=102.5;\qquad\therefore v^2=\frac{2\times102.5}{0.5}$

$\therefore v=\sqrt{410}\approx20.6\,m/s$

16.



$T-mg=\frac{mu^2}{r}$

$T-mg=\frac{m\left(\sqrt{7gr}\right)^2}{r}\Rightarrow T=8mg$

17. Energy $=10^{-20}J=\frac{10^{-20}}{1.6\times10^{-19}}=0.625\times10^{-1}$ = 0.06 ev

18. $h=60m$; $\frac{dm}{dt}=15kg/s$

$\frac{90}{100}\frac{mgh}{t}=P$

$\Rightarrow P=\frac{9}{10}\times15\times10\times60=9\times900=8.1kW$

19.

$$K.E = 3(P.E)$$

$$\frac{1}{2}m[2g(S-h) = 3\times mgh$$

$$\Rightarrow S-h = 3h$$

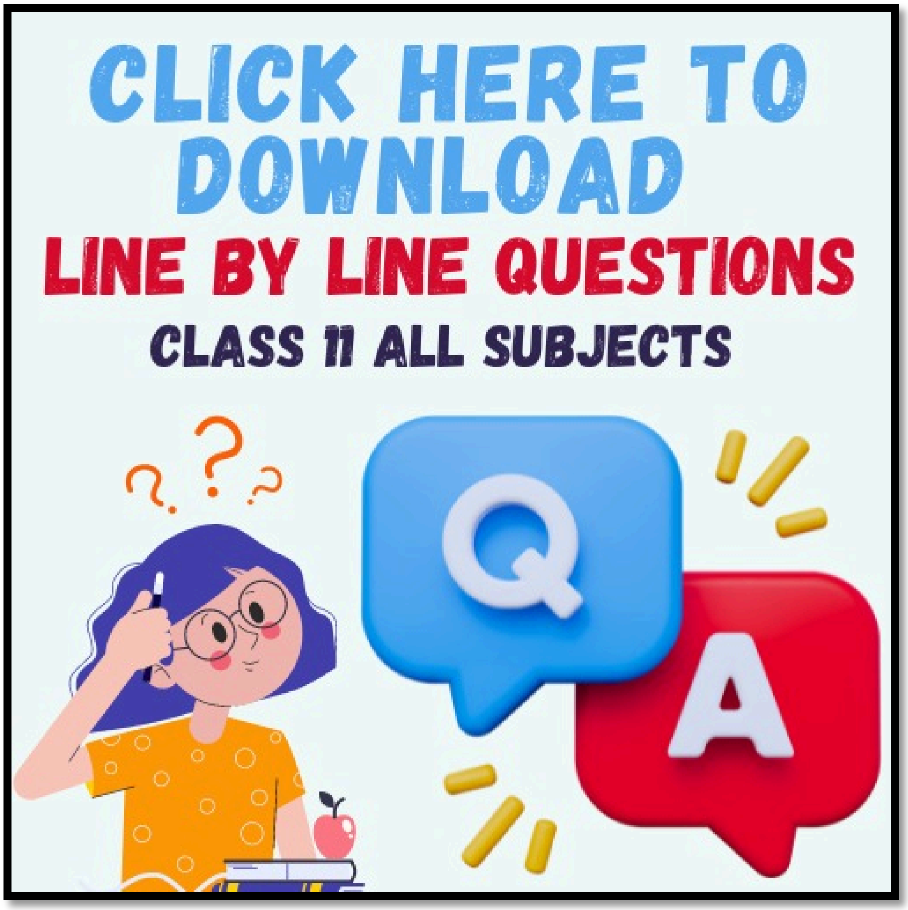
$$S = 4h$$

$$\Rightarrow h = \frac{S}{4}$$

And speed $V = \sqrt{2g(S-h)}$

$$= \sqrt{2g(S-\frac{S}{4})}$$

$$= \sqrt{2g\times\frac{3S}{4}} = \sqrt{\frac{3gS}{2}}$$



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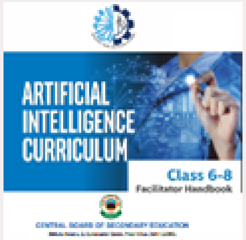

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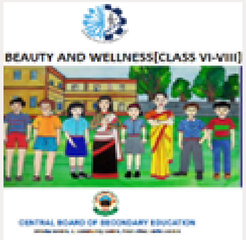

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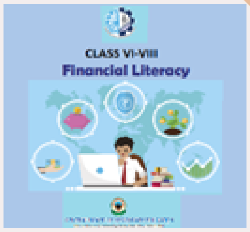

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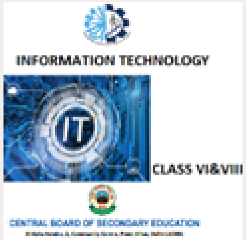

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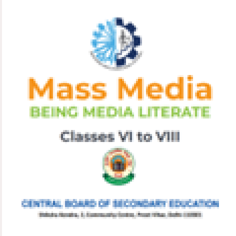

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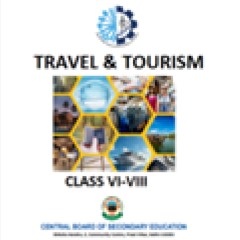

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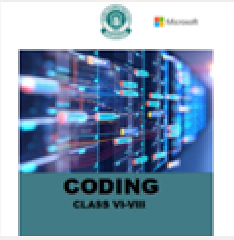

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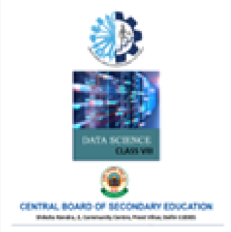

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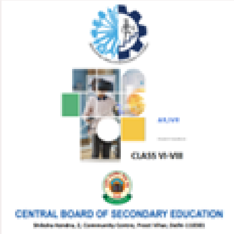

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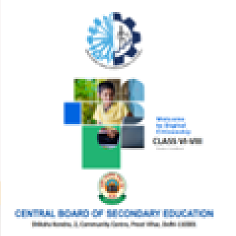

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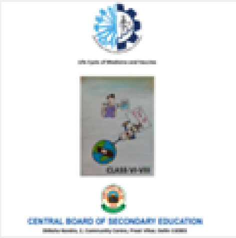

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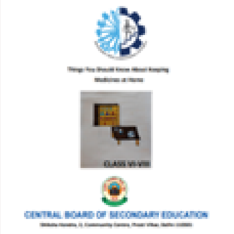

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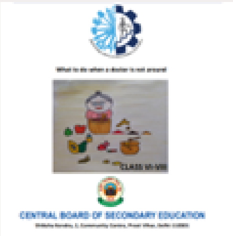

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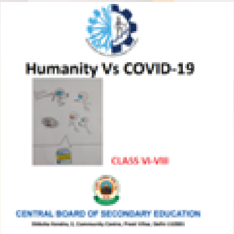
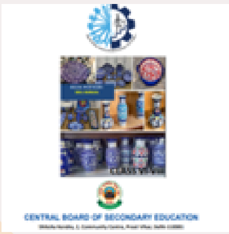
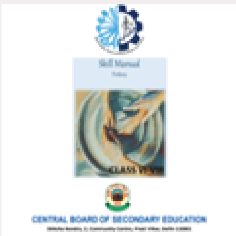


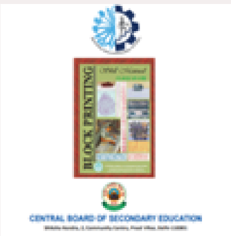
Humanity & Covid-19



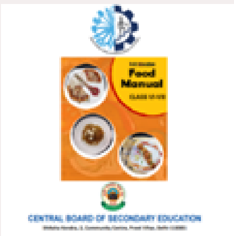
Blue Pottery



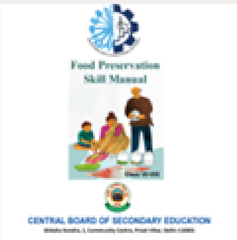
Pottery



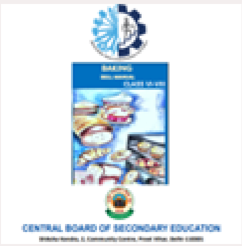
Block Printing



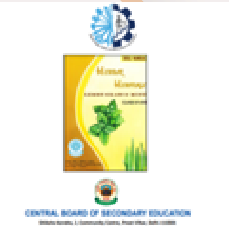
Food



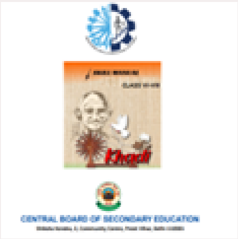
Food Preservation



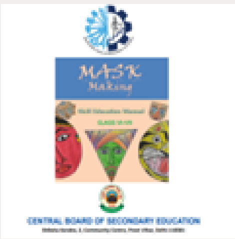
Baking



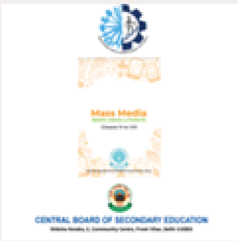
Herbal Heritage



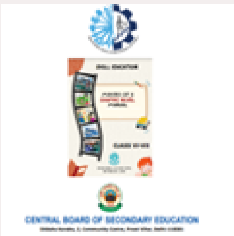
Khadi



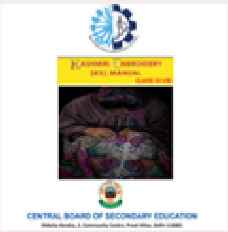
Mask Making



Mass Media

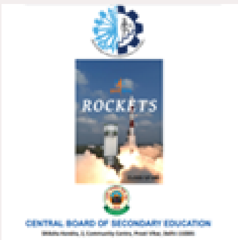


Making of a Graphic Novel

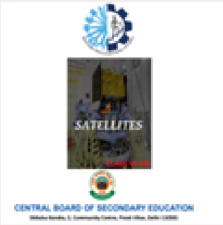


Kashmiri Embroidery

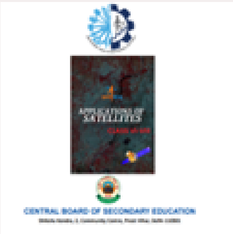
Embroidery



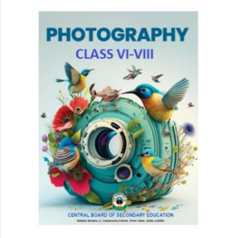
Rockets



Satellites

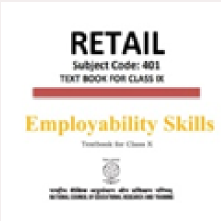


Application of Satellites

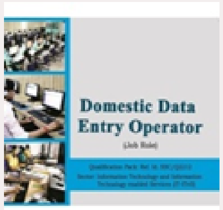


Photography

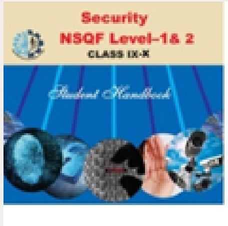
SKILL SUBJECTS AT SECONDARY LEVEL (CLASSES IX – X)



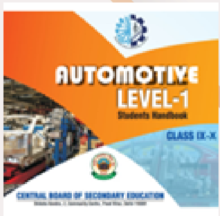
Retail



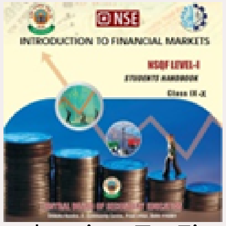
Information Technology



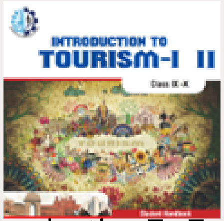
Security



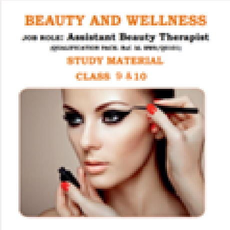
Automotive



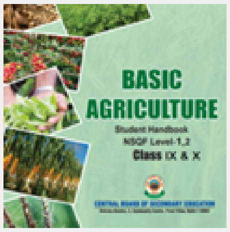
Introduction To Financial Markets



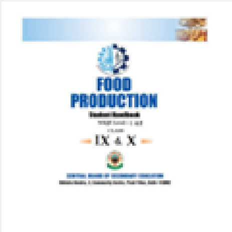
Introduction To Tourism



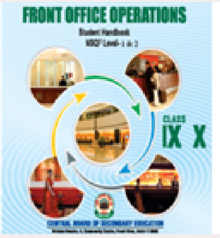
Beauty & Wellness



Agriculture



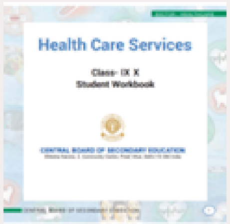
Food Production



Front Office Operations

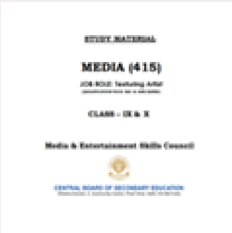
Banking & Insurance

Marketing & Sales



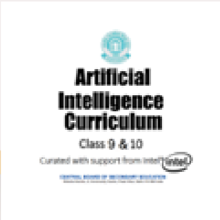
Health Care

Apparel

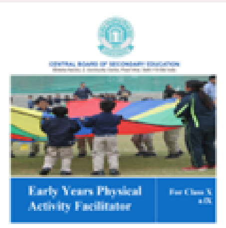


Multi Media

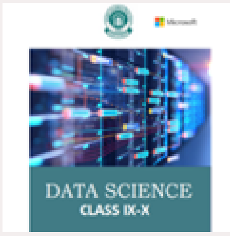
Multi Skill Foundation Course



Artificial Intelligence



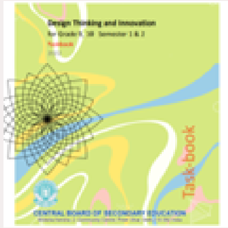
Physical Activity Trainer



Data Science

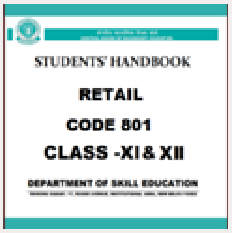
Electronics & Hardware (NEW)

Foundation Skills For Sciences (Pharmaceutical & Biotechnology)(NEW)

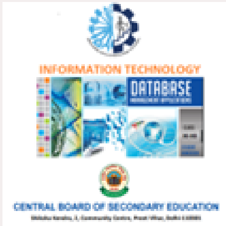


Design Thinking & Innovation (NEW)

SKILL SUBJECTS AT SR. SEC. LEVEL (CLASSES XI – XII)

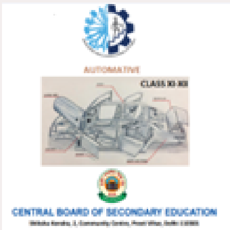


Retail



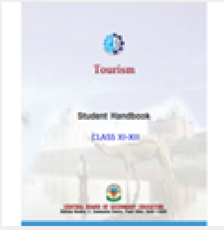
InformationTechnology

Web Application

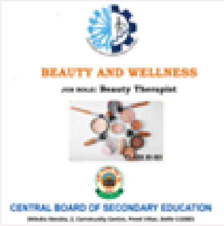


Automotive

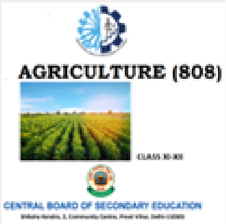
Financial Markets Management



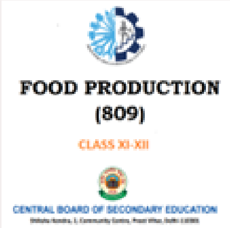
Tourism



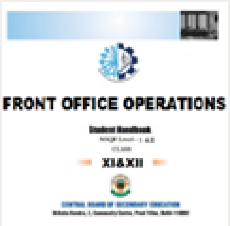
Beauty & Wellness



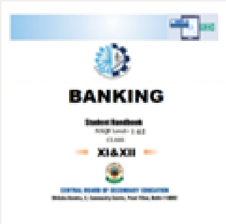
Agriculture



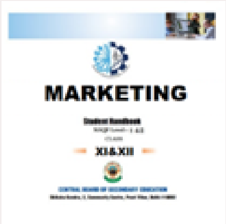
Food Production



Front Office Operations



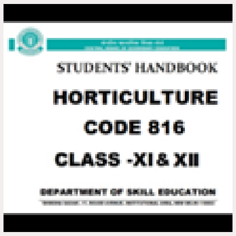
Banking



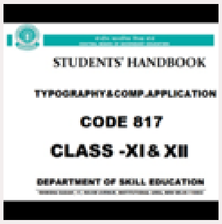
Marketing

Health Care

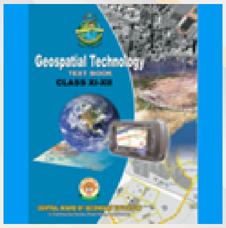
Insurance



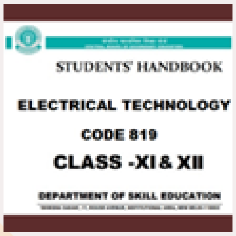
Horticulture



Typography & Comp. Application

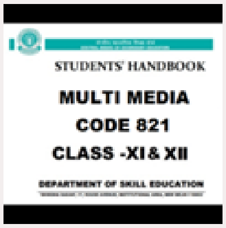


Geospatial Technology

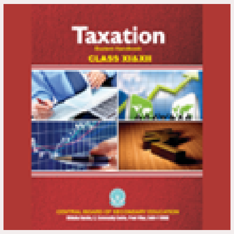


Electrical Technology

Electronic Technology

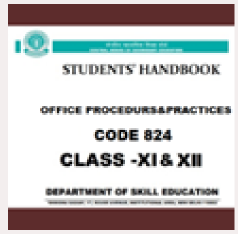


Multi-Media

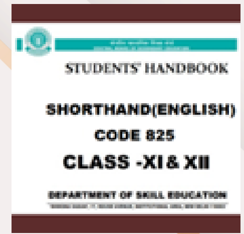


Taxation

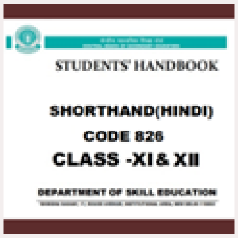
Cost Accounting



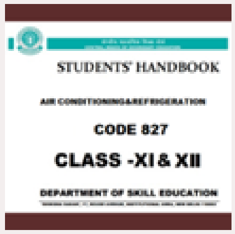
Office Procedures & Practices



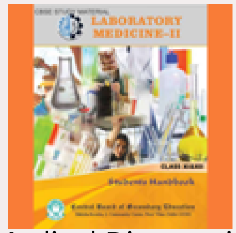
Shorthand (English)



Shorthand (Hindi)

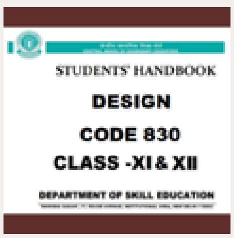


Air-Conditioning & Refrigeration

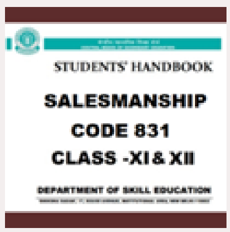


Medical Diagnostics

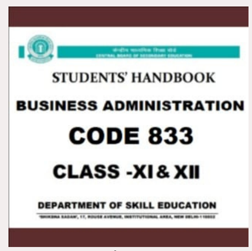
Textile Design



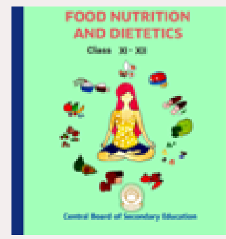
Design



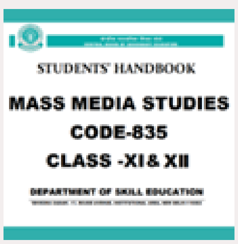
Salesmanship



Business Administration

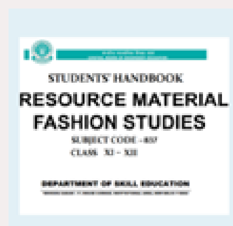


Food Nutrition & Dietetics

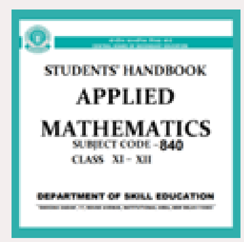


Mass Media Studies

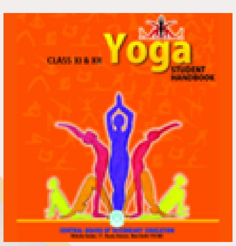
Library & Information Science



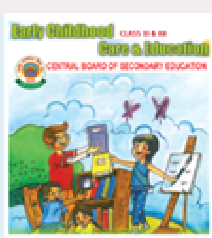
Fashion Studies



Applied Mathematics



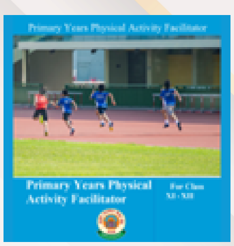
Yoga



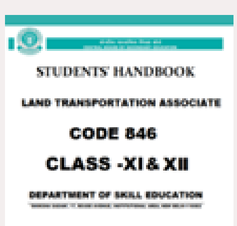
Early Childhood Care & Education

Artificial Intelligence

Data Science



Physical Activity Trainer(new)



Land Transportation Associate (NEW)

Electronics & Hardware (NEW)

Design Thinking & Innovation (NEW)